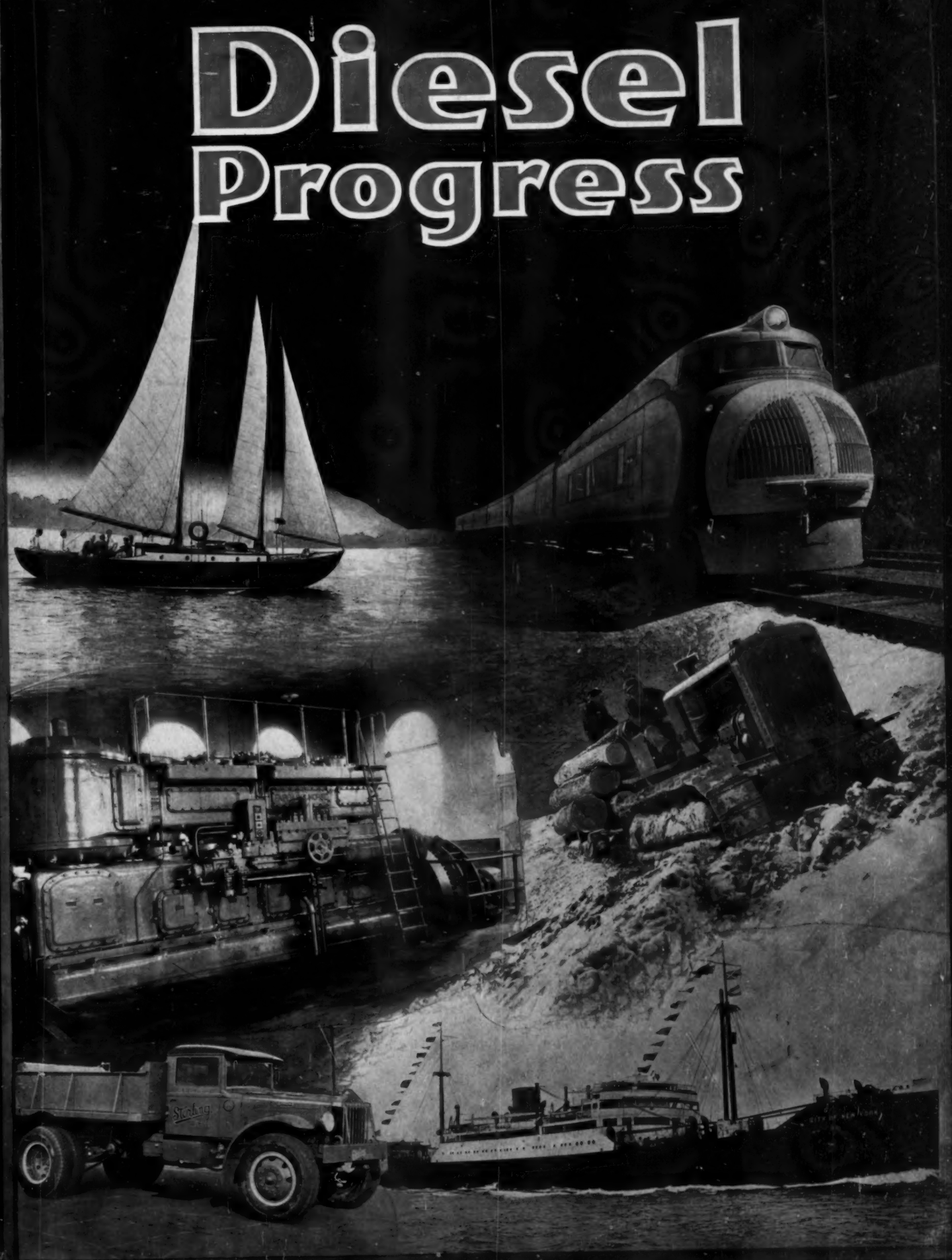
Diesel Progress

IN INDUSTRY · IN TRANSPORTATION · ON THE SEA · IN THE AIR



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GULF

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SATCO* BEARING METAL

SATCO* METAL BEARINGS play an unseen but highly important part in the modern trend of rail transportation. All main and connecting rod bearings in the Winton Diesel engines which power the Union Pacific's Streamline Train M 10,001 and the Boston & Maine's "Flying Yankee" are lined with Satco* Metal.

The success or failure of these "trains of the future," as an element in more efficient and economical transportation, depends largely upon the ability of the mechanical equipment to withstand the terrific strains imposed. Bearing metals, in particular, have been subjected to speeds and loads which the babbitt manufacturer of a decade ago would have considered beyond the capabilities of any standard-composition alloy. But the almost uniform freedom from serious breakdown which has characterized the trial runs of these new streamlined trains is an indication that bearings, as well as other parts of the mechanical equipment, have been improved almost as radically as the design of the trains themselves.

An important advantage of Satco* Metal may be found in its nearly ideal structural formation. As most engineers are aware, the good performance of a bearing metal depends to a great extent on its structural formation. The bearing metal with a structure of relatively hard microscopic particles intimately and uniformly dispersed throughout a softer matrix will exhibit the desirable qualities of hardness and resistance to transverse and crushing stresses as well as the ability to adapt itself to the ordinary play of a shaft.

We welcome inquiries for further information and prices on Satco* Metal bearings.

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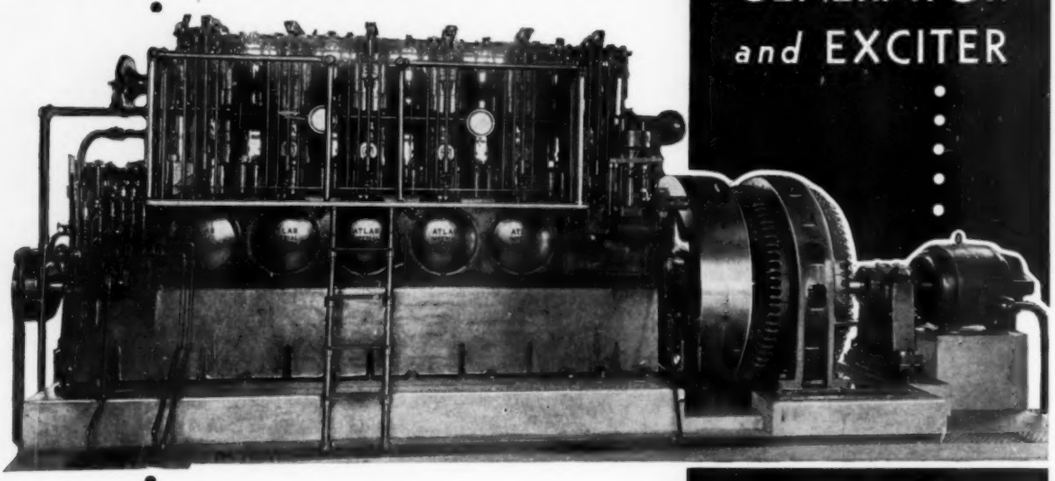
INDIANA

Augusta, Kansas, adds this small unit and:

an ELLIOTT GENERATOR and EXCITER



are an asset to any Diesel engine installation. They do their full share toward making the unit successful. Their use assures quiet, smooth, dependable, cost-saving operation.

cuts its rates 33%

Two 376-kw., Diesel engine-generator units were installed in this municipal plant. But careful study of the plant load factor showed that both at peak loads and the low hours of the night, the units were not running economically. It was seen that a third unit of approximately half the size of the others would be a paying investment.

This unit was installed — an Atlas-Imperial engine driving a 175-kw. Elliott generator with direct-connected exciter. An immediate improvement was observed in operating costs, which is becoming more marked as time goes on. The new unit is operated ten hours out of twenty-four. Resulting economies show a 25% reduction in overall plant fuel cost, and savings of 50 to 60% in plant lubricating oil. These economies assisted the city government to extend a 33% rate reduction to the citizens.

The operation of the unit as a whole is very satisfactory.

A detailed story of the Augusta, Kansas municipal plant is contained in the Spring, 1935 issue of POWERFAX, quarterly magazine published by Elliott Company. If you are interested, we will gladly send a copy upon request.

ELLIOTT COMPANY

PITTSBURGH, PA.

Electric Power Department

RIDGWAY, PA.

District Offices in Principal Cities

J-641

DIESEL PROGRESS

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Editor and Publisher.....REX W. WADMAN
Managing Editor.....JOHN E. OSMUN
Circulation Manager.....M. E. FERRITER

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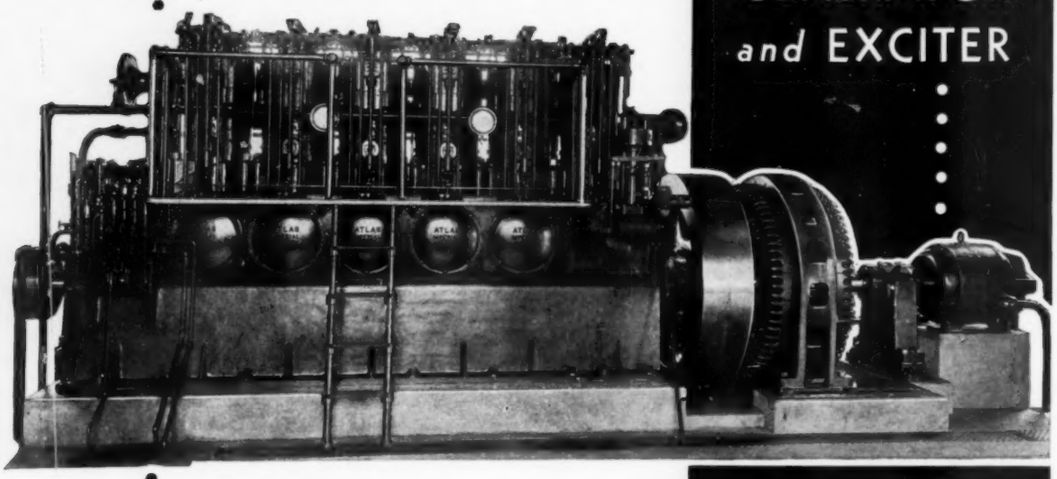

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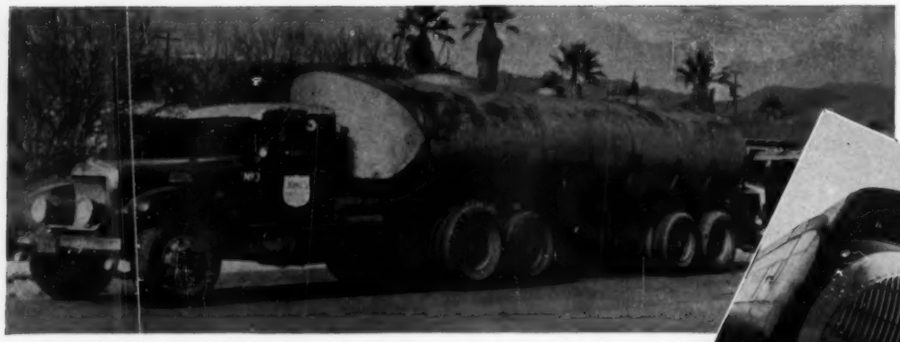

"ALNOR" PORTABLE PYRO POINT PYROMETER

FOR

MOBILE DIESELS

AN Exhaust Pyrometer is needed as much for the multi-cylinder Mobile Diesel as for the stationary or marine Diesel.

This is true whether the engine be a 20-hp. or a 2000-hp. unit. The cylinders of the Mobile Diesel can become unbalanced, the injection nozzles can wear or become clogged, the timing can become incorrect and other maladjustments can develop often more readily than with the stationary Diesels because of the added jolts and jars incident to mobile use.

The "Alnor" portable Pyro Point can be used to serve any number of Mobile Diesels, as it can be taken from engine to engine with no more difficulty than any other small tool.

With a thermo-couple permanently inserted in the exhaust pipe of each cylinder it requires only a minute or two to check the several exhaust temperatures of an engine. No connecting wires or conduit is required and there is no installation expense.

Every truck, bus, tractor or Diesel locomotive maintenance man, as well as every Diesel engine field man or service man, will find the Pyro Point a very useful instrument. It will quickly pay for itself in time saved in making engine adjustments and in assuring more efficient and more economical Diesel operation.

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DIESEL PROGRESS

REX W. WADMAN, Editor and Publisher

SOMETHING new – something economical. After all is said and done, that is what the Diesel Engine really is – something new, something economical. Despite the fact that oil burning engines have been in use for twenty-five years or so in this country, it has only been since the big slide started back there in 1929 that the Diesel really started coming into its own.

I didn't begin with askings. I took my job and I stuck; I took the chances they wouldn't, an' now they're calling it luck.

** * * * and they asked me how I did it, and I gave 'em the Scripture text, "you keep your light so shining a little in front o' the next!"*

They copied all they could follow, but they couldn't copy my mind,

And I left 'em sweating and stealing a year and a half behind.

—RUDYARD KIPLING,
The "Mary Gloster"

In these hectic five years this country, individually and collectively, has been looking for "something new, something economical." And in a way they've found it, they've discovered the one basic reason for the Diesel engine's existence – its ability to do more for less, its inherent characteristic of economical operation. Slowly but surely the recognition of this inherent trait and its application to varying power problems was spreading throughout the country up to 1933, but it was a slow, hestitant growth, as is evidenced by a chart which appears in this issue. Then came 1934 with its new this and new that and despite our very human trait of resistance to new ideas, the urge to find "something new, something economical" overcame our inertia and the Diesel was rediscovered and taken to our bosom in no uncertain manner. In 1934 we bought and put to useful, economical work almost twice as much horsepower in Diesels as in the previous all time peak year of 1928.

And so I offer you DIESEL PROGRESS, a new magazine to better picture for you the wide and ever widening application of the Diesel. As we have done in this issue, we will earnestly try, in the following issues, to interestingly, illustratively and accurately portray to you the many uses to which the Diesel is being placed, to occasionally suggest to you new uses of this splendid economic factor in our commercial life. We will strive to hold your interest and, as editor and publisher, I will welcome your comments and constructive criticisms, especially on this our first issue.

Rex W. Wadman

A NAVAL ARCHITECT LOOKS AT THE SMALL YACHT DIESEL

SOMEWHERE in your reading during the last few weeks you may have come across the current slogan of one of the largest industrial corporations in the country – "An Eye to the Future – an Ear to the Ground." That sentiment typifies almost exactly how the yachting world today regards the small Diesel.

A tremendous wave of boating has swept over the country in the last ten years. From crowded highways people have turned to open waterways. Once they are the owners of a boat, a man and his family become a band of adventurers, discoverers, filled with the lure of travel and exploration, thrilled with a sense of new found freedom. For the business man, a small cruiser aboard which he can spend vacations and week-ends with chosen friends, there is welcome rest from work and worry. Dull care vanishes and life begins – not at forty, either – but the moment he becomes the owner and takes the wheel.

Strange as it may seem the depression years, any one of them, failed to see a decrease in the total registration of motor boats, as federal government figures will prove. It is somewhat mystifying. Nevertheless despite the fact that the last four years witnessed a substantial decrease in the number of new boats built, as compared with the high tide of prosperity, the boat and engine manufacturers have managed to weather the storm surprisingly well as a whole, and production figures for 1935 have taken an upward curve.

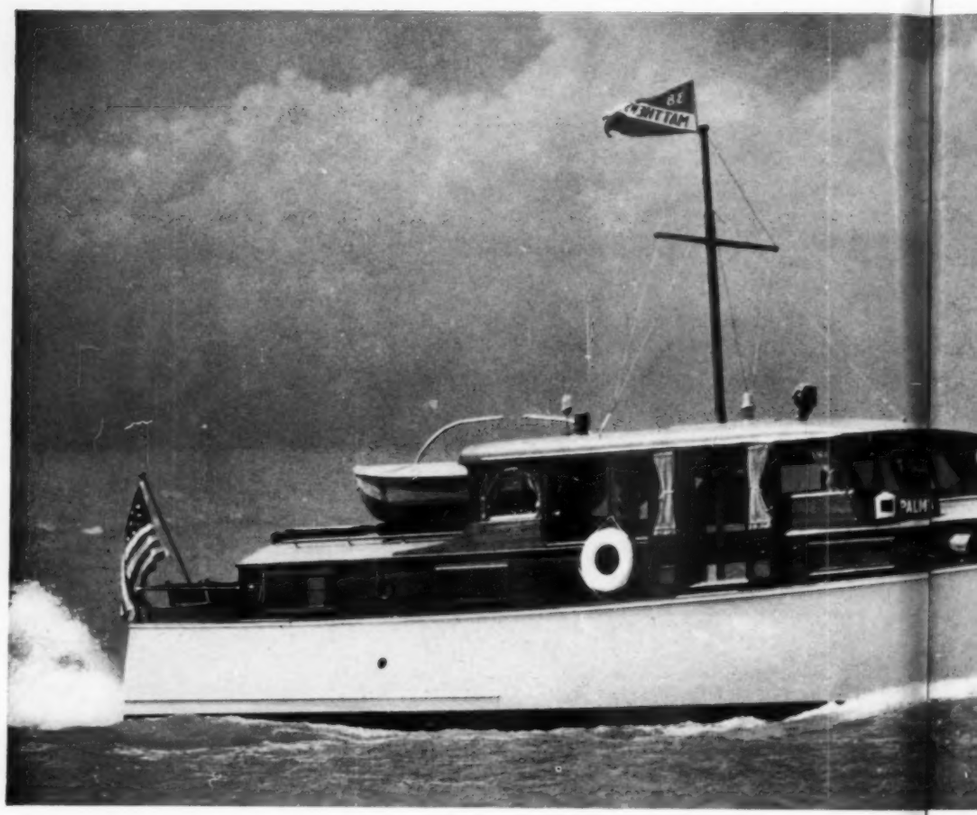
What the gasoline marine engine did to make possible the rapid growth of small boating during the past ten years, the small marine Diesel holds every promise of doing within the next ten. Both engine and yacht builders are keeping an eye to the future – an ear to the ground. Another significant fact – boat buyers and prospective owners all ask about Diesels now. Ten years back it was a rarity for the small boat buyer to ever inquire about Diesel power. But times have changed with progress.

Ten years ago there was no marine Diesel built in this country suitable for the propulsion of small yachts. A boat of 110 feet was the smallest hull for which a Diesel engine could be considered on account of its size, weight and height. Five years ago the smallest hull in which a Diesel could be made to operate satisfactorily in all respects was one about 60 to 65 feet. Remember now we are speaking about yachts, and the yacht owner is one of the most exacting type of buyers to be met. Esthetically he demands more of a boat than any other class of buyer. With him, appearance, quietness of operation, speed, convenience and comfort are all questions of cardinal importance.

Today the hull limits for a satisfactory small Diesel installation has come down to thirty feet. Since the majority of all cruising craft, dependent solely upon motors for their propulsion, are between 30 and 50 feet in length, a sizable field confronts the manufacturer of the small marine Diesel engine today.

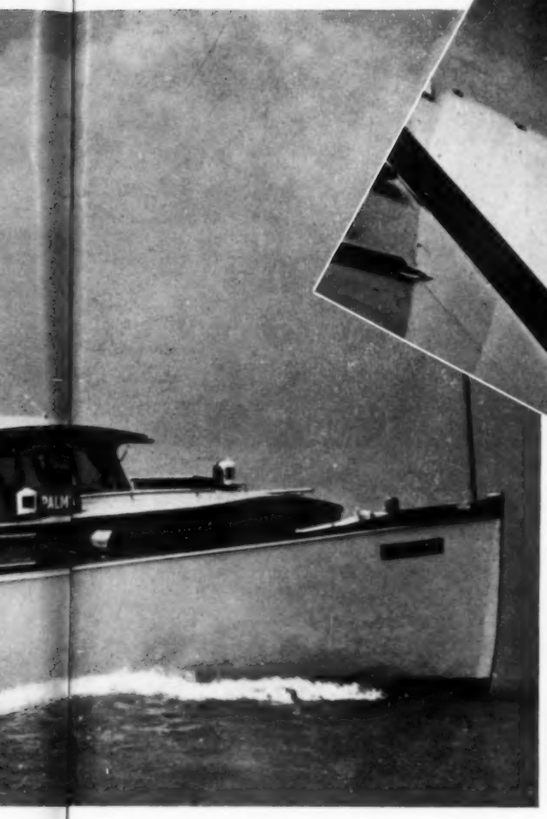
Engine replacements must be made from time to time as they wear out. Owners often decide to have more motor power, or perhaps the engine he has is more costly to operate than he can afford at present. Here is the ace in the hole – a Diesel.

Briefly some of the improvements that have brought Diesel power within the buying focus of the small yacht owner's eye, are first, reduction in size and weight; second, the increases



This 38 foot double-cabin cruiser will cruise 18 to 20 hours on 250 gallons of Diesel fuel but only 12 hours on same quantity of gasoline.

By WALTER J. McINNIS
NAVAL ARCHITECT



n 250
soline.

The author at work.

in revolutions per minute; third, improvements in fuel injection systems; fourth, quieter operation and lessened vibration; fifth, better control of fuel combustion odors; and sixth, the decrease in price per horse power per pound.

Practically all yacht Diesels today are the airless injection type. Light-weight, high-speed craft employ straight direct drive. For the heavier, slow-speed boat reduction gears, responsible for the solution of many former power transmission problems in the last few years, are employed.

From engines once limited to from 300 to 400 rpm.'s the Diesel industry has developed efficient marine plants with as high as 2,000 revolutions per minute. Through a combination of engine speeds and reduction gears the yacht designer has been given a greatly increased range of effective propeller revolutions, suitable to every yachting demand. And by going into a higher number of revolutions per minute and lowering the engine weight through the use of new light-weight metals, the manufacturer of marine Diesels has now cut the price per horse power per pound nearly in half!

What are the most important advantages of Diesel engines over gasoline engines in small pleasure craft? There are several, including unquestioned economy, which is an important one among yachtsmen today. The owner of a boat can operate a Diesel engine at about one-third the cost of a gasoline engine. Even though the yachtsman doesn't have to pay a tax on his gasoline for the upkeep of the highways his gasoline bill is still higher than he thinks it ought to be. This is one of the first things he demands to know when buying a boat.

Another very important advantage is a greatly increased cruising radius with the same size hull. By burning fewer pounds of fuel per horse power an hour, less fuel storage space is required than the yacht would need if that space were devoted to gasoline tanks. With the equivalent space for Diesel fuel oil,

cruising radius is greatly lengthened. For the yachtsman who goes South in the winter, or the adventurer who wants to go on an extended cruise in strange waters off the beaten track, that is an indispensable advantage.

Lastly, there is the elimination of the explosion hazard. Newspaper headlines in recent years have made many people conscious of the risk of gasoline vapor mixed with air. There are times when a yacht owner will forget to thoroughly ventilate his cabin and engine compartment before starting his engine after his boat has been moored for several days with hatches and ports tightly closed. And there are still people who light pipes and cigarettes anywhere without thinking. Security from explosion hazards with a Diesel engine is worth a lot to any buyer.

While the earlier Diesel engines were largely two-cycle in principle and often of the semi-Diesel type requiring some auxiliary means of heating them to get them started, today these motors are to a large degree four-cycle and will start cold as readily as any gasoline engine. This feature, coupled with electric starters, has done much to win over the yachtsman to their use.

One of the problems of the small Diesel in the past has been the difficulty of metering the fuel uniformly to get even performance in all cylinders. Even now the yacht owner should be impressed with the necessity of keeping the spray valves clean. The high velocity of the fuel through the spray nozzles used to cause wear, increasing the diameter slightly, but enough to result in getting varying amounts of fuel oil into each of the cylinders. And again, due to the problems of engineering there was lack of sufficient precision, some of the tiny holes being either a little too small or a little too large. Where diameters are measured in thousandths of an inch it is easy to see where a slight deviation from the engine designer's specifications or inaccurate measurements in diameter measurement when drilling the holes, could result in unsatisfactory performance. But these early troubles have been eliminated by the Diesel engine builders and the modern type of fuel injection and fuel pump is highly efficient and easy to take care of in daily operation.

Were I a manufacturer of small marine Diesels seeking my market in the yachting field, I would pay special attention to the necessity of having an absolutely tight engine which would not allow any fuel oil to leak out into the bilges and soak into the wood where the odor would be an objectionable feature to the owner. It is a practice now to build a drip pan under the engine bed with some means of pumping out any oil that may accumulate there. I would also be careful about turning up the engine speeds to high velocities unless I were assured that it would maintain them. Manufacturers of high-speed gasoline engines, too, have trouble here in holding up their engines to very high revolutions per minute.

No marine engine has yet been produced that will give the yachtsman all he desires, but the Diesel today stands well at the head of the field in efficiency and economy of operation. Improvements in small Diesels have come along so fast that one can hardly keep track of them all.

What the ultimate result will provide for the yachtsman in the near future is hard to prophesy, but I am of the opinion that it may come down to some sort of an effective compromise between the present fuel oil engine and the modern Diesel. But only the future can tell. Designing boats and selecting power plants

. . . . *And now please turn to page 42*

Outward Bound.

w York T

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NEW YORK, FRIDAY, MARCH 15, 1935.

Reich Burns Oil in Planes; Would Foil Radio Beams

Report That It Has Perfected Device to Sto Ignition Motors Is Revived—Diesels' Employment in Bombers Seen.

By FREDERICK T. BIRCHALL.

Wireless to THE NEW YORK TIMES.

BERLIN, March 14.—German aviation is tending to adopt the Diesel motor, which burns oil. This entails a 65 per cent saving in fuel costs. The motor also has a better safety coefficient and it is also much quieter in operation. Civil planes have been modified to Diesel requirements in the matter of snout and exhaust, and the noiseless airplane may be said to be already in sight.

This dispatch, of course, covers only civil aviation. The characteristics of the planes in the newly revealed air force are military secrets concerning which no authoritative information is available and information is available and in- ...ously discouraged. ...be a rea... ...quiet ...

have long been experiment... discover a wireless system ... lines of the Marconi radio b... stopping gasoline motors a... tance. They were impelled ... efforts a few weeks ago by ... that the Germans already ... an invention, effective a... plane motors at the grea... four miles. And they ... preted this as the reas... Germans are paying so ... tion to Diesel motors, ... not being operated by ... would not be affected.

Not the least confirmation of any such German success is obtainable here, nor could there be, for the reason already ... However ...

A tri-motored Junkers plane equipped with Diesel aircraft engines. This is the first tri-motored Diesel ever to be exhibited.

Photo from European

DIESELS IN WAR PLANES

WHEN *The New York Times* gives front page space to the news that Germany is adopting Diesel engines for aviation—it must be important.

Diesel engines for aircraft are by no means a new development, but much of the work with aircraft Diesels up to the present has been of an experimental nature, and forecasts of Diesel engines more powerful than the present gasoline engines are now being made.

In Germany, experimentation with Diesel engines not only continues at a lively pace, but Diesel equipped planes are now being flown over long, arduous routes under actual operating conditions. It is in the giant sized planes where Diesel efficiency and economy is most pronounced. The saving in fuel costs amount to as much as 65 per cent over gasoline motors, and in addition the Diesel engine is quieter in operation, and the danger from fire or explosion is considerably less.

About five years ago, the Lufthansa began experimenting with empty planes equipped with single Diesel engines. After a year and a half of testing, these engines were greatly improved, and in 1932 a freighter was Diesel equipped for regular service. Diesels were not used in German passenger planes until 1933. Last year they were installed in the first bi-motored machine.

The Lufthansa now has eight planes fitted out with Diesel engines, and one other is soon to be equipped. There is the giant four-motored Deutschland, one tri-motored plane and six single motored ships. At Dessau, the Hindenburg, sister ship of the Deutschland, is now under construction. Its power plant will consist of four Diesels. All these engines were built by the Junkers Company.

The types of Diesel engines used in German civil aviation are the Juno-4, 750 hp., and the Juno-5, 550 hp. The Juno-4 is the older and more developed type and is used exclusively for passenger planes. The Juno-5 is a newer engine, and still needs further development before it is entirely satisfactory. Any mechanical difficulties will be corrected under actual operating conditions, such as those encountered by the Deutschland on her regular flights between Berlin, Copenhagen and Malmoe, Sweden.

It has been pointed out that any improvements instituted in Diesel engine construction in the civil field of aviation can be quickly adapted to the needs of military aviation. If there is any truth to the rumor that a Marconi radio beam has been discovered which will put aviation gasoline motors out of commission at a distance of four miles, then indeed, there will be a rush of Diesel experimentation and development under actual flying conditions, so that gasoline motors may be replaced on airplanes by Diesel engines whether or not circumstances so demand.

STAGING A COMEBACK

Diesel Trains Are Popularizing Railroad Travel

SPEED! The goal of to-day and to-morrow! Railroad trains became popular years ago because people and goods could be speedily transported hundreds of miles.

And then came the automobile – first considered a transportation fad to be laughed at. Remember the derisive yell "Get a Horse."

But, a couple of decades later, railroad trains were actually being passed by speedy cars and trucks moving along concrete highways paralleling the railroad!

In the modern urge for speed the popularity of the railroad declined but a comeback is already evident.

It is the Diesel powered train that is responsible. Light weight, streamlined and air conditioned trains make travelling a comfort while being operated at high speeds with safety.

The first train of this type to be used in the East "The Flying Yankee" has been placed in regular service by the Maine Central R.R. and the Boston & Maine R.R. after an exhibition tour of New England and test runs in regular operations over the two roads. This new Diesel streamlined train is to make a daily mileage of nearly 700 miles. Starting from Portland it is to run to Boston, then a round trip from Boston to Bangor and an evening run from Boston back to Portland.

On March 4th this new Diesel streamlined train clipped eighty-five minutes off the running time between Bangor and Boston in the first speed test over the route on which it will operate in regular service.

The flyer is capable of speeds in excess of 100 miles an hour, but in actual operation it is the quick acceleration and deceleration rather than the high maximum speed, that is of importance. In the recent test run, the "Yankee" clicked off mile after mile at from 55 to 75 miles an hour.

On the first part of the trip, from Bangor to Portland, the new train made the 135.4 miles in 170 minutes and the 114.6 miles from Portland to Boston in 103 minutes. This latter trip was run non-stop. Compared with the old running time between Boston and Bangor of six hours and five minutes for the steam "Flying Yankee," the Diesel "Flying Yankee" made it in four hours and 40 minutes.

Built in Philadelphia by Edward G. Budd Mfg. Co., the "Flying Yankee" is a three section articulated unit, powered by a 600 hp. Diesel engine supplied by the Winton Engine Division of General Motors Co. Constructed of light weight, corrosion proof stainless steel, the entire train weighs only 212,000 pounds including the Diesel power plant. It is 199 feet 2¾ inches in length, with seats for 144 passengers. The forward section, in addition to carrying the mechanical equipment, has baggage compartment, buffet and seats 28 passengers. The second section has two compartments, one seating 24 passengers and the other 36. The rear section seats 36 passengers and has an observation lounge with 20 armchairs.

Into the discard, now goes the old "Flying Yankee," which formerly ran from Boston to Portland.

The Winton Diesel engine is 8 cylinder 8″ x 10″, two cycle uniflow scavenger type, weighing about 22 lbs. per horse power, and provides the power that makes possible speeds of over 100 miles per hour. Operating costs are only 35 cents per mile including wages of crews, fuel, maintenance and depreciation.

Certain distinguishing features will be of special interest to engineers who will find innovations in the welding of the steel frame member and the new spiral three-lobe air blower. Keen interest has also been shown in the engine design, since this Winton engine is the only commercial Diesel in which air is intro-

Built by the Winton Engine Division of General Motors Corp., this 600 hp. Diesel furnishes the power for the "Flying Yankee."

Right—In the observation lounge or solarium the chairs are upholstered in a deep green fabric which blends with the sidewalls and draped curtains.

duced at the lower end of the cylinder liners, and the burnt gases are expelled through the valves in the head.

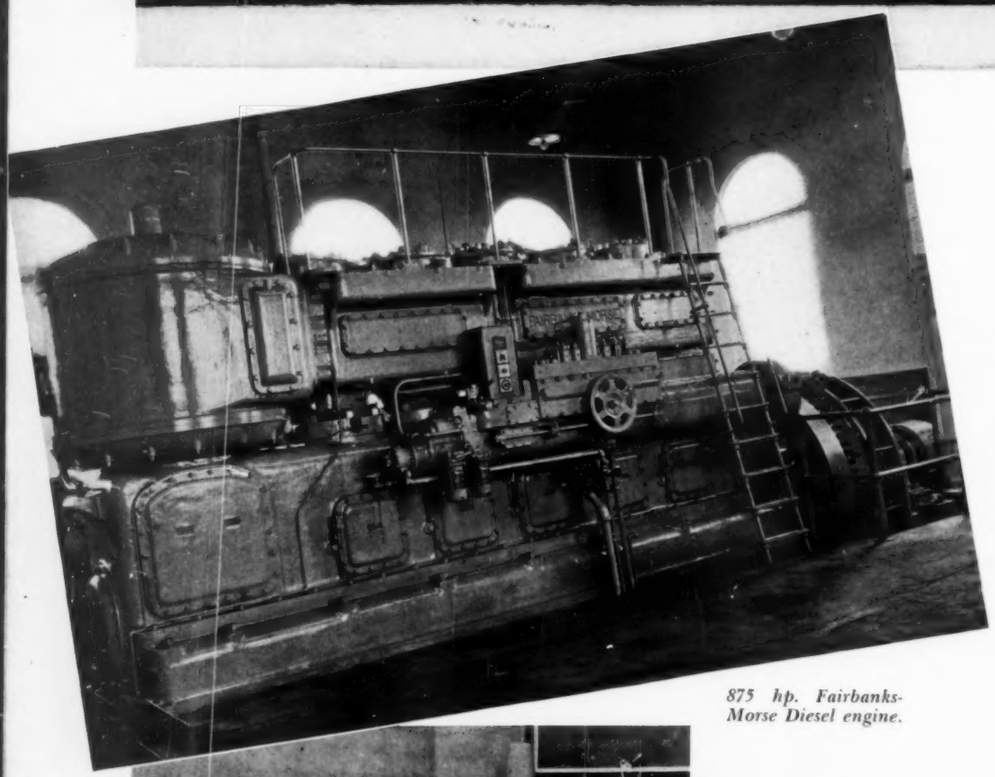
In the interior, everything has been designed with a view to the comfort of the passengers. The train, of course, is air-conditioned and thoroughly insulated both for heat and sound so that a constant temperature is automatically maintained. Rubber insulation has been used extensively in the trucks to prevent the transmission of sound and vibration to the car bodies. Windows are constructed of double sashes of shatterproof glass hermetically sealed to form a vacuum between them, thus preventing steaming or frosting.

"The Flying Yankee" is the third Diesel powered streamlined train to be built and placed in service in this country. Public interest in this new type of rail transportation continues at a high level as is witnessed by the fact the 9,431 persons passed through the train during its six hour exhibition stay in Boston.

Revived interest in rail transportation in competition with the motor bus and private car is being materially aided by the leading railroads' adoption of Diesel engines.

In these new Diesel powered, streamlined trains, everything has been designed with a view to the comfort of the passenger.

Litchfield's Municipal Light Plant.



875 hp. Fairbanks-Morse Diesel engine.

400 g.p.m. Fairbanks-Morse motor-driven turbine pump handles main city water supply.

LITCHFIELD PROFITS

IN 1898 Litchfield, Minn., voted a $25,000 bond issue to construct a municipal light plant. Today that plant, greatly enlarged, is paying handsome dividends and in addition to serving Litchfield with light, heat, power, steam and water, is also taking care of the electrical requirements of several adjoining communities.

This municipal power plant started with two 75 kw. steam units and additional steam units were added until a 750 kw. turbine generating set was bought in 1931. In 1933 the electrical load was increasing rapidly but the steam load was standing still, so an 875 hp. 606 kw. Fairbanks-More Diesel generating set was added.

Litchfield has proved that heat balance, where steam heating is not required for certain periods of the year, can best be obtained by a combination steam and Diesel plant, with the Diesel carrying the full load in the summer and acting as standby in the winter. This economical plan is saving approximately $9,000.00 a year over full steam operation.

Further results secured have been lower rate schedules; free electric service for street lighting, municipal buildings, etc. The plant's net earnings are now $26,000.00 per year and taxes in Litchfield are 25% lower than the neighboring town of Hutchinson, served by a private utility. It DOES PAY to install a Diesel generating plant.

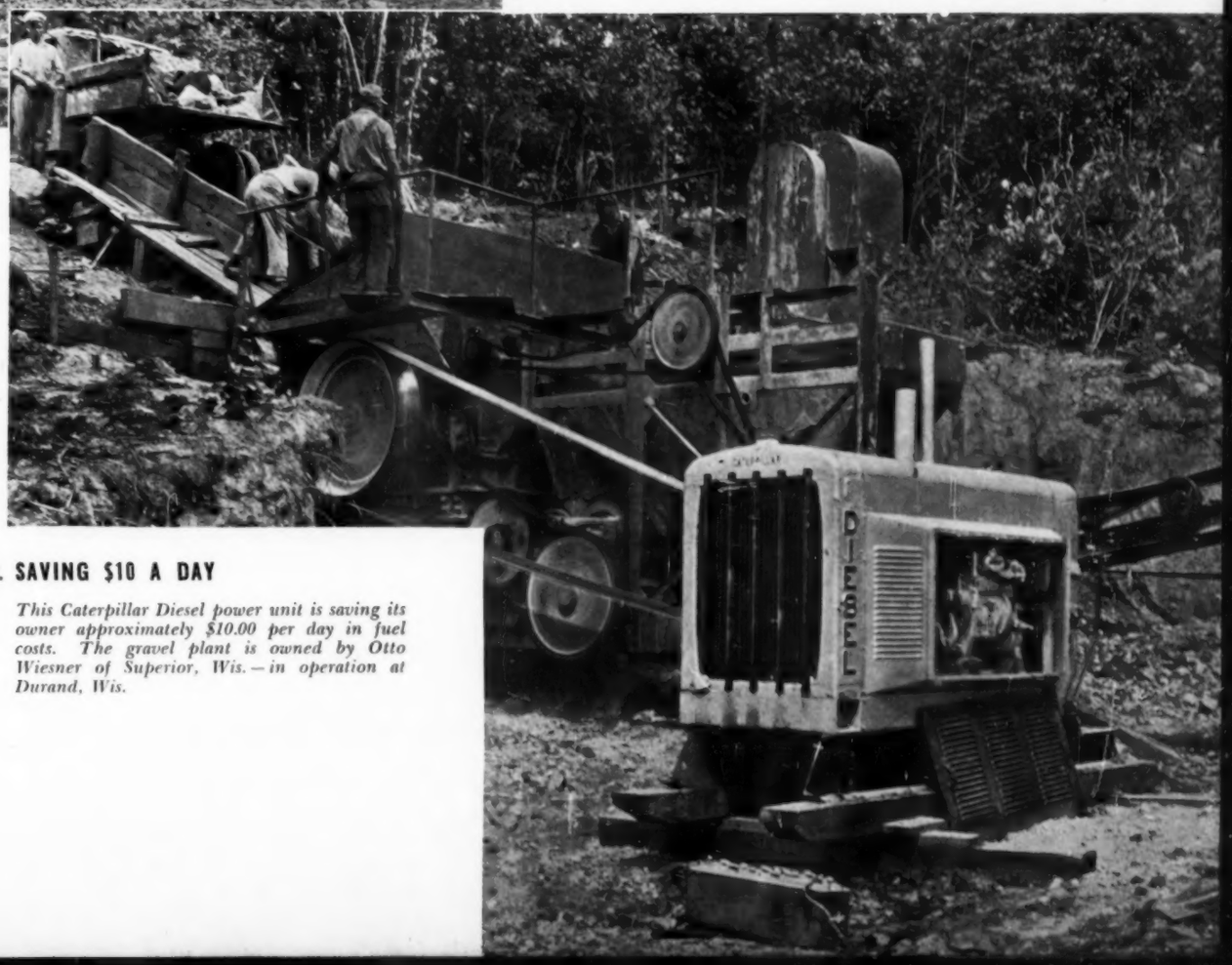
1. PUMPING SAND

Benton, Ala., Diesel unit operating sand pump at a fuel cost and oil cost of $2.50 a day. Handling 350 gravel 200 tons in 2 hours. Material pumped through 22 ft. of 8" pipe against 45 ft. head. Consumes 4½ gals. fuel per hr. J. H. Whigham owns three, all operating gravel pumps — one at Benton; one at Flomaton, and one at Townsboro, Ala.

2. CRUSHING STONE

Caterpillar power unit operating a Diamond Stone Crusher on the Skyline Drive project near Luray, Va. Owner: Sammons-Robertson Co., Huntington, Va.

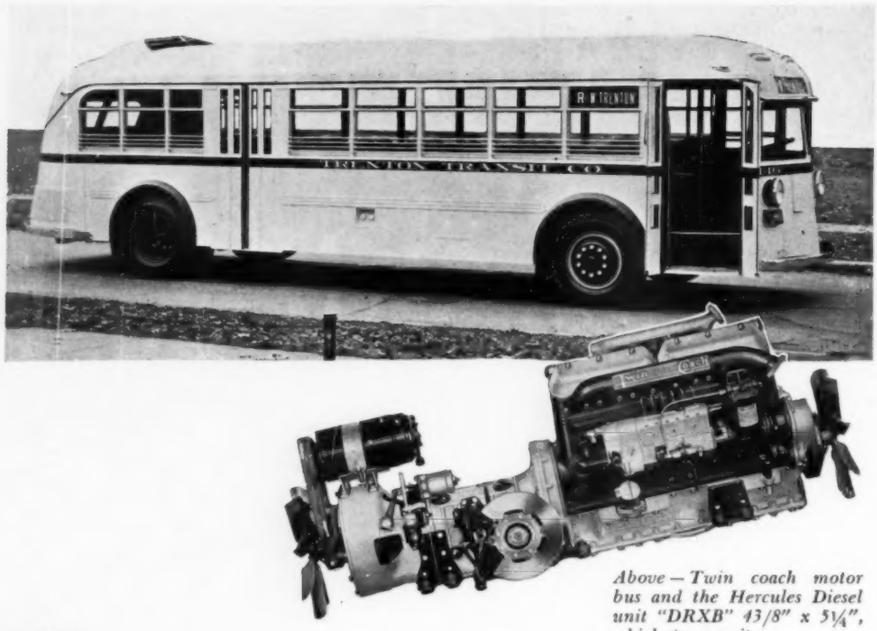
DIESELS IN QUARRIES



3. SAVING $10 A DAY

This Caterpillar Diesel power unit is saving its owner approximately $10.00 per day in fuel costs. The gravel plant is owned by Otto Wiesner of Superior, Wis. — in operation at Durand, Wis.

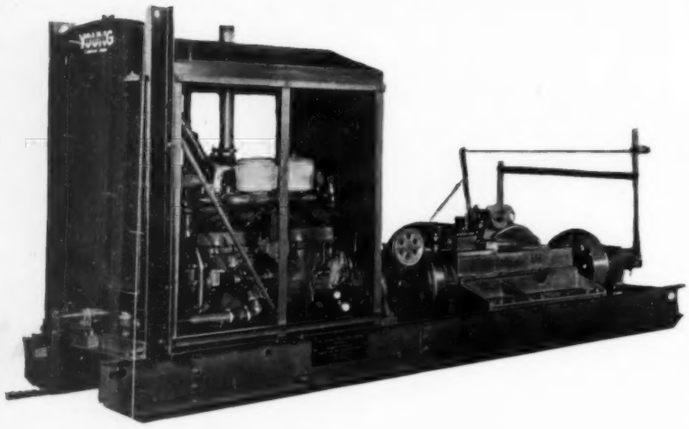
DIESELS ARE MOBILE



Above — Twin coach motor bus and the Hercules Diesel unit "DRXB" 43/8" x 5¼", which powers it.

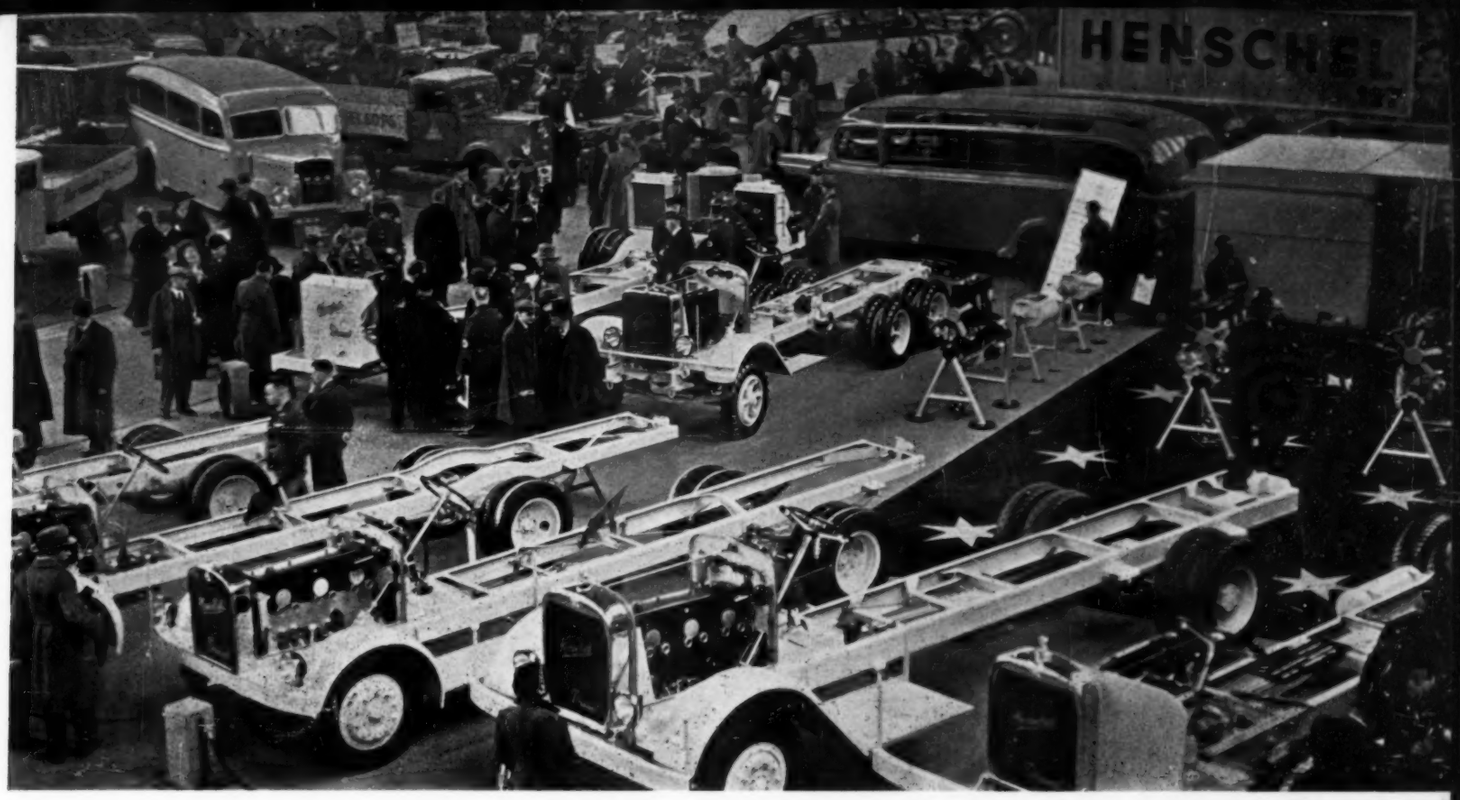
ONE of the outstanding advantages of a Diesel engine is its mobility. Wherever there is a need for reliable, economical power, Diesel engines are to be found on the job operating 24 hours a day when necessary. That is why Diesels are used in such widely diversified types of operation as motor transportation, oil drilling, farming, sand pumping, stone crushing, road construction, railroading and shipping.

Diesels have long been recognized as a most efficient source of industrial and municipal power. Through their mobility, they have also proved most practical for outside jobs of many kinds and for construction work and transportation. These sturdy engines today are entering a new era of development in transportation, where they are operating successfully and economically in tractors, buses, trucks, boats, streamline trains and aircraft.



Left — A drilling rig manufactured by the Young Engine Company, and driven by a "DHXB" 5" x 6" Hercules Diesel.

Below — Another Model "DHXB" 5" x 6" Hercules Diesel is installed in this truck made by the Kenworth Motor Truck Co.



BERLIN MOTOR SHOW DOMINATED BY DIESELS

Over 90 per cent of the commercial vehicles exhibited are Diesel-engined.

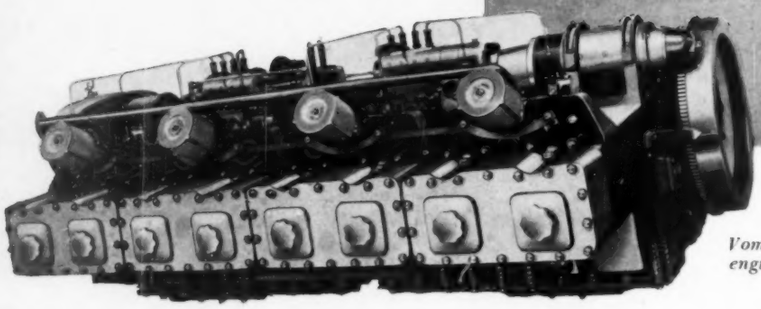
By H. S. BAUER

THE tremendous development in road transportation which is taking place in Germany was emphasized in an unusual manner at the Berlin Motor Show this year. The outstanding point of interest was that the high speed Diesel equipped, commercial vehicle has won complete nation-wide acceptance and adoption. Not only are over 90 per cent of the trucks and busses thus equipped, but fire engines, ambulances, tractors, snow shovels, mail vans, field kitchens, furniture vans, road tankers, garbage collectors, milk tanks, rail cars, water sprinklers, telegraph service wagons, etc., also are Diesel driven, varying in power down to the little Primus four-wheeled "horse" that has two-cylinder Deutz engine of 25 hp. and sells for about $1,100.00.

This Berlin Motor Show was one of the most successful held not only in Germany but in

Hitler examines the eight cylinder, 180-200 hp. horizontal Vomag Diesel on a chassis for the German Railway Co.

Streamline Diesel bus.



Vomag horizontal Diesel engine of 185-200 hp.

any country, and the tremendous interest displayed by the public indicated the intense national interest in the vehicle exhibited.

The Diesel element becomes apparent immediately on entering the Hall of Honor at the Berlin Show, for displayed singly on pedestals are vehicle-Diesels by Krupp; M.A.N.; Junkers; Daimler-Benz; Humboldt-Deutz; Maybach; Magirus; Vomag, and Bussing-Nag. These engines apparently are placed there as a symbol of this *new* German industry, and are unattended. I use the term "new" not in the sense that the Diesel is new to Germany, for it was a German engineer of that name that gave the Diesel to the world, but because of its commercial development and adoption, in weights and speeds, for road vehicles to the point of almost completely displacing gasoline power is very recent. Most of these engines follow conventional design, and a close look has to be given to differentiate them from ordinary gasoline units. One engine in the Hall of Honor is a departure from regular practice; this is a 320 hp. Bussing-Nag motor designed to operate on butane and propane, and which has two crankshafts and two sets of cylinders in parallel. One striking engine, which illustrates just how far standard design has gone is the M.A.N. 12-cylinder, V-type unit for a rail car, developing 420 bhp. at 1400 rpm. Then, in another hall, is the Junkers opposed-piston type motor. The inventor of this design of Diesel, Professor Junkers, also famous for the aeroplane of the same name, died quite recently.

One must pass through the commercial vehicle halls to obtain a true picture of the great advance that has taken place, for here hardly a gasoline truck or bus is to be seen. I also only noticed one Diesel-electric vehicle, namely an A.E.G. bus that has been running on the Berlin streets in an experimental way. The A.E.G. are now developing their own high-speed Diesel, and a number should be in commercial operation in conjunction with their electric transmission gear in about another twelve months.

From an engineering point of view, perhaps the most interesting chassis was that for a streamline bus of large carrying capacity. This chassis has a 145 hp. Bussing-Nag Diesel engine at each end, with the drive from each engine on one of two sets of somewhat centrally located rear wheels, the arrangement of which can best be seen from the accompanying illustration. Controls for both engines are from the driver's seat forward. With this arrangement the traction effort, or starting torque, must be very great.

All engines are not of conventional design, as Krupps of Essen have a number of vehicles with horizontal opposed-piston, air-cooled Diesels, as well as the Junker vertical type opposed-piston motor; while Vomag have an eight-cylinder 185 hp. horizontal engine, the consequent height of which is very low for the output of power. There are quite a number of wood-burning vehicles, the gas from the charcoal retorts fueling the internal-combustion engine. Apparently this system is proving quite economical and satisfactory from a technical standpoint, and is making considerable headway in Germany in open competition with the Diesel engine in certain sections of the country where wood charcoal fuel can be obtained easily and cheaply. One company is specializing in the replacing of gasoline motors with M.W.M. Diesels without any substantial changes to the chassis. The cost for

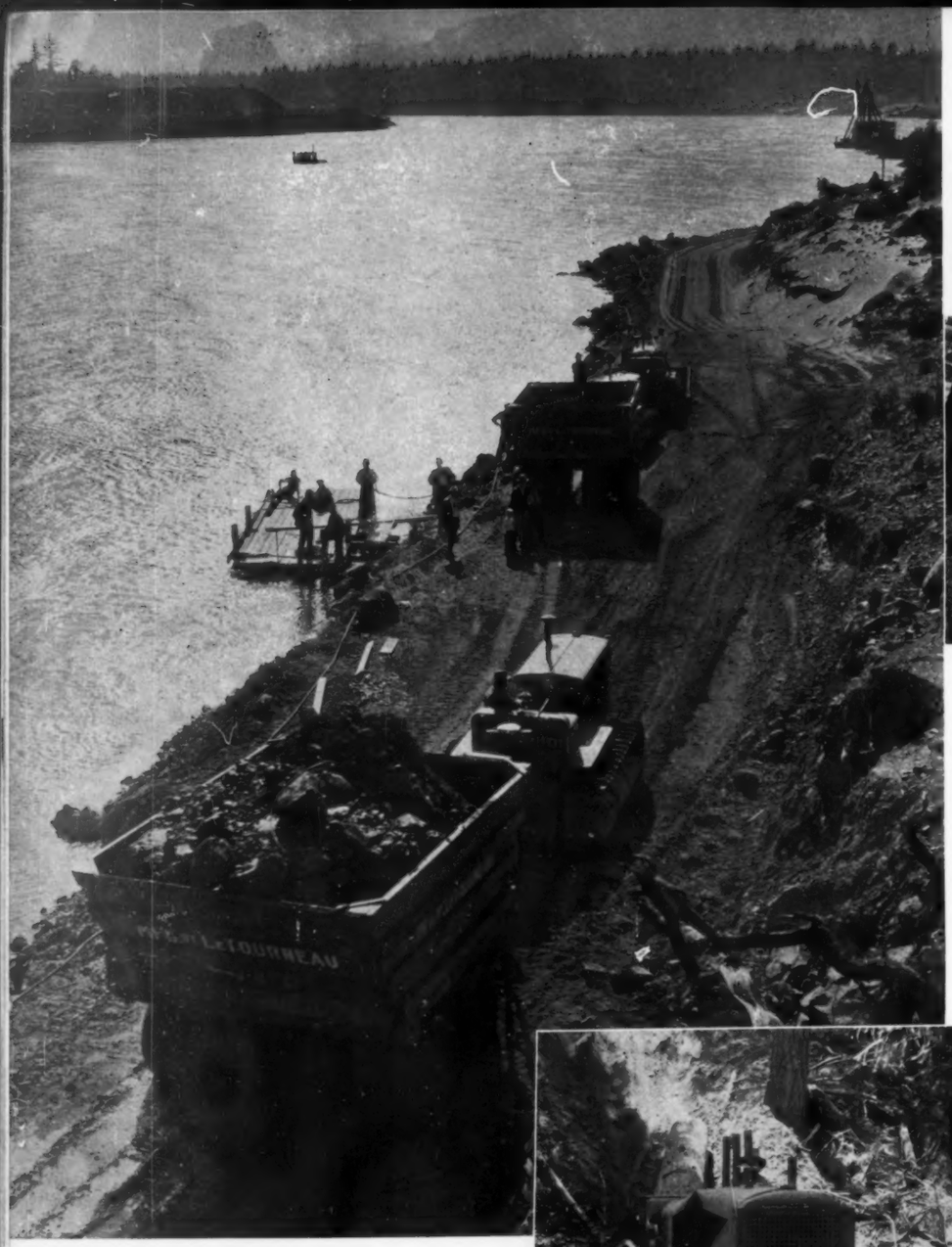
. . . . . *And now please turn to page 42*

Mercedes-Benz streamline bus.

Bussing-Nag heavy Diesel truck with trailer.

M.A.N. bus with 90 hp. 6-cylinder Diesel motor.

Bussing-Nag chassis with two 145 hp. Diesel engines and duo drive.



DIESELS SAVE AND MAKE MONEY

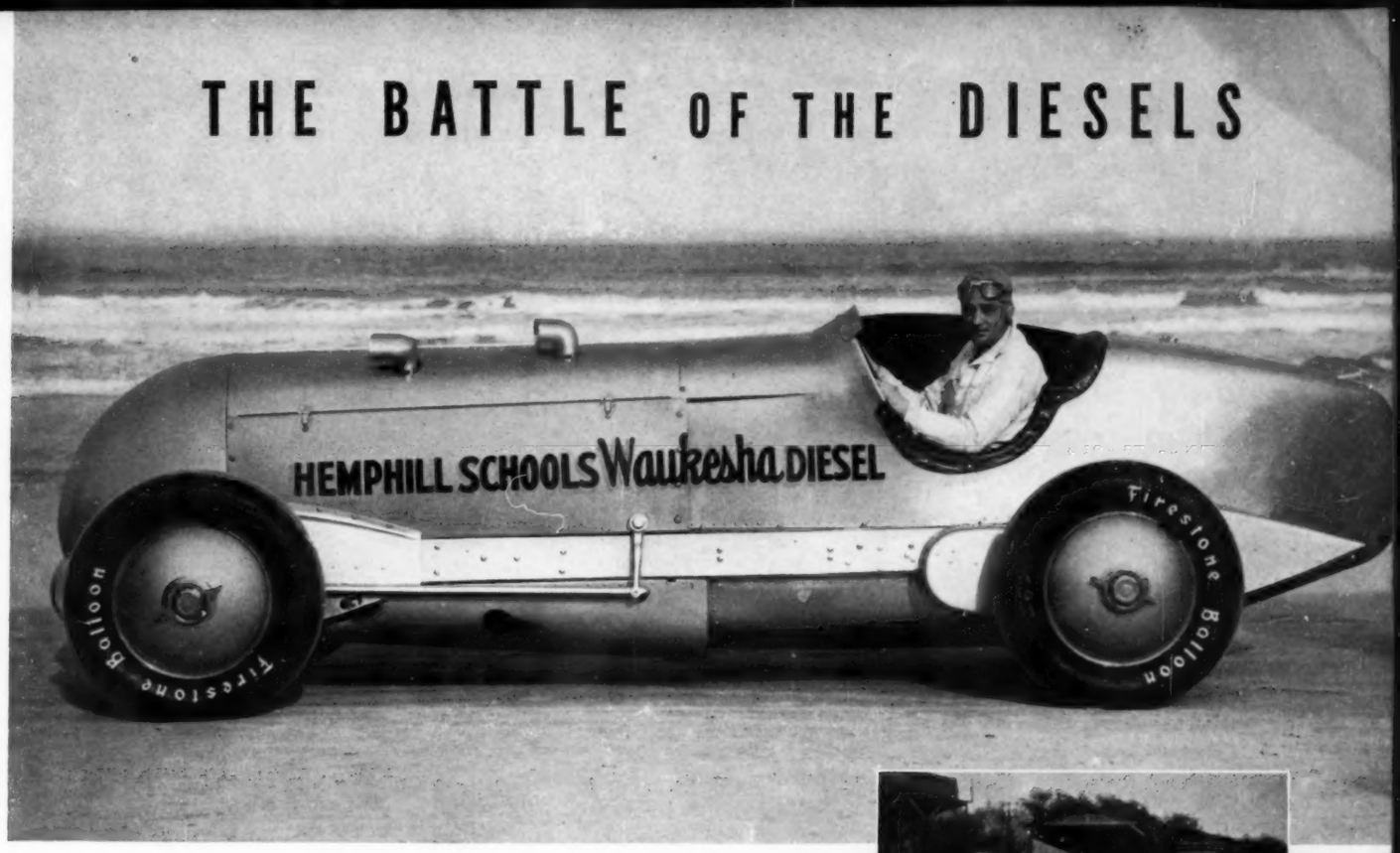
Above—One of the five Caterpillar Diesel Seventy Fives with La Plant-Choate 2-way dump wagon on the A. E. Dick Construction Company job for the Pennsylvania & Reading Coal Company, on their stripping operation at Locust Gap, Pa., hauling from a Bucyrus Erie 52-Diesel Shovel.

Upper Left—Diesel Tractors working on the Bonneville Dam on the Columbia River. A $31,000,000, three-year job. Two Caterpillar Diesel Seventy Fives pulling LeTourneau Buggies, two of a fleet of Diesels working for the Columbia Construction Company, North Bonneville, Wash.

Center—Logging with a Diesel Tractor in Southern Oregon. An Allis-Chalmers Diesel Tractor operating successfully under difficult conditions.

Lower Left—A Caterpillar Diesel Power Unit installed on Tandem Cedar Rapids Straight Line crushing plant, on the George Orr Construction Company operation near Flagstaff, Arizona.

THE BATTLE OF THE DIESELS



AT DAYTONA BEACH, FLORIDA

The Diesel speed record comes back to America with an officially timed run of 137.195 miles per hour.

Above—Wild Bill Cummings in his Cummins Diesel. Standing beside the car is C. L. Cummins, President of the Cummins Engine Co.

Top—Dave Evans in his Waukesha Diesel.

RECENTLY at Daytona Beach, Florida, the battle of the Diesels was renewed in earnest, resulting in at least one world's engine speed record for the United States for cars powered by Diesel engines.

First to go into action was Dave Evans' Waukesha Silver Comet. He turned in a new world's record of 125.065 miles per hour by bettering the English figure of 120.33 mph. made by George Eyston on a French track.

The Waukesha engine is a standard stock engine with a displacement of 648 cubic inches. It is not supercharged and has no special racing gadgets. The engine has six cylinders 5″x 5½″ with regulation United American Bosch fuel injection system, Leece-Neville electric starter, aluminum pistons, seven-bearing crankshaft, and the patented high velocity Comet combustion chamber.

The fuel supply system is the only portion of the standard engine which has in any wise been altered, and in this case the change was merely to increase the capacity of the injection and primary supply pumps so as to avoid any likelihood of a fuel shortage at sustained high speeds. Nozzles are of the standard Bosch spring loaded pintle type which provides a simple single orifice rather than a multiplicity of very fine small spray holes.

But Evans' world record was not destined to last for long. On March 2, Wild Bill Cummings, National AAA Champion for 1934, went out on the beach with a Cummins Diesel racing car and burnt up the track for a new world's record of 137.195 miles per hour.

The Cummins Diesel engine is a standard Model H. A. 6-cylinder, 4⅞″x 6″ engine. It is supercharged by a standard supercharger of the same specifications as those used on regular truck engines sold for service in high altitudes.

Thus the battle of the Diesels rages with two world's records made in quick succession, and more undoubtedly soon to follow.

DIESEL OPERATION IS AT LEAST 2

By FRANK M. PRENDERGAST

SO SAYS ARVID G. OHLIN PORT ENGINEER R. O'BRIEN & CO.

OF all those whose business takes them down to the sea in ships probably none face more hazardous odds to make a profit than the operator of a fishing fleet.

Seen through the eyes of story tellers and writers of adventure the deep sea fishing business is a picturesque one filled with peril, romance and heroism, of ships lost and men that never return.

But seen through the eyes of a fishing fleet owner it's a business that today demands machinery that can "take it" as well as men. Keenly competitive, the fishing industry has had to fight for its existence and there have been periods in the last few years when its "net" profits turned out to be anything but *net* profits. The fishing industry is one business where ideal working conditions never exist.

To earn money on its investment a modern fishing vessel must be forever on the move. A trawler makes no money for her owners, when she is moored at her dock. The fishing industry has arrived at mass production long since, and with it has been brought face to face with the problems of mass production.

The race is not only to the swift, but to the shrewd. Propelling machinery and equipment must be picked that will stand the gaff 24 hours a day, 26 days a month without failure, and more often than not, working under the worst possible conditions.

Here he Diesel has met its crucial test — and passed it with flying colors. First disdained, then challenged and finally acclaimed, it has revolutionized the fishing business as completely as the power loom revolutionized the textile business.

Go down to the big Fish Pier in Boston some morning if you're in that vicinity when two blasts of a horn atop the Administration Building announces the arrival of one of these modern Diesel trawlers. Watch her hull grow bigger on the harbor horizon and see her purr smoothly to her berth. If she's one of the O'Brien vessels she's probably returning from an eleven-day trip to the Western Banks off Canso, Nova Scotia, with her holds loaded with fish. Before noon the next day she'll be all unloaded, her tanks refueled and headed out again for the Banks. Not much romance perhaps, but efficiency aplenty.

Of the hundreds of fishing craft that market their catch at the Boston Fish Pier probably none are better known than the vessels of the R. O'Brien fleet for their day-in and day-out performance without a halt. Throughout the year these eight sturdy trawlers average 31 trips of 11 days each, logging roughly 1500 miles to the trip.

Once they leave the dock their engines never stop turning. On the fishing grounds the trawlers drop their nets and sweep the depths thirteen times a day. When fish are scarce they must hunt until the schools are found. Sixty miles a day is a fair average of one of these trawlers — and it is brutal work — for any engine.

Once a year, when fish prices are low, in the late spring, they are given a thorough overhauling. Two weeks for painting, repairing, a rigging inspection with replacements if necessary, engines taken down, each part gone over for signs of wear, pistons cleaned, and they're ready for another year's tasks.

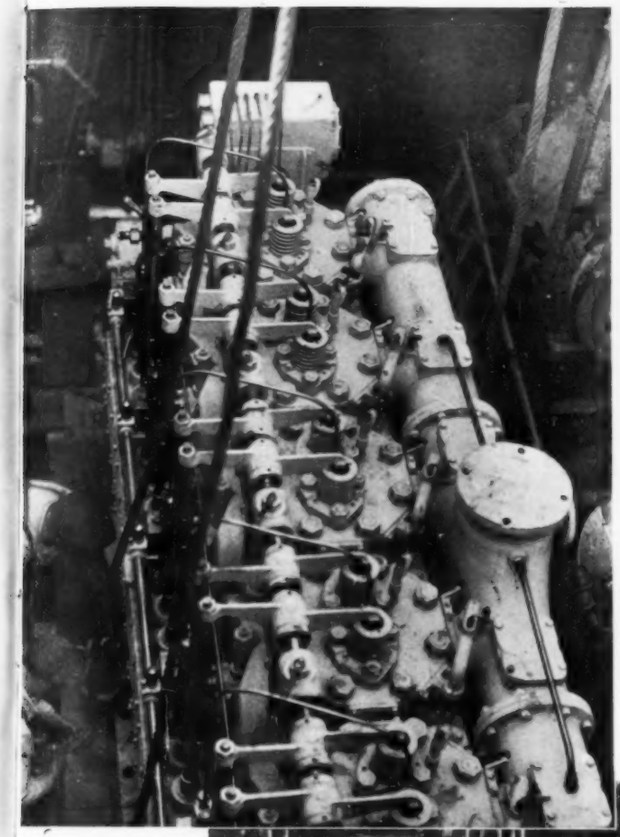
The running time of the engines average 7,255 hours a year. There are 8,760 hours in a year of 365 days. So allowing for time spent unloading, just figure out for yourself the small number of hours left in the year when these engines are not turning over!

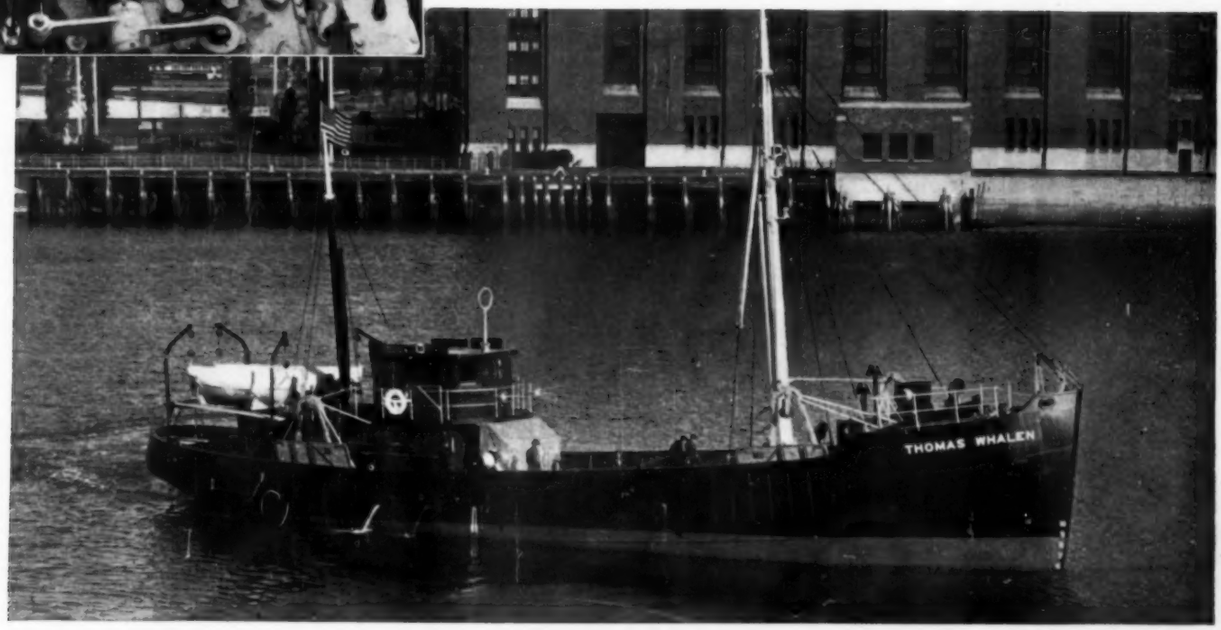
Just for the fun of it imagine driving your automobile at its maximum speed loaded to capacity with all the passengers you could carry, over rough roads where your car would lurch and sway, up and down a succession of short steep hills, day and night for eleven days at a time! Repeat this 31 times in a year. Would your automobile take this punishment with only one overhauling? The Diesel engine in a fishing vessel does it.

It was in 1928 that R. O'Brien & Co. decided to build its first trawler. Previous to that time the company operated on a basis of shares in other vessels. It commissioned the Bethlehem Shipbuilding Corporation at Fore River, Quincy, Mass., to build the WILLIAM J. O'BRIEN. Of the entire O'Brien fleet, she is still the largest ship, measuring 114.9 feet, and is powered with a 380 hp. Bethlehem. In addition to her main engine she has two others, a 90 hp. Bethlehem Diesel auxiliary which furnishes power to operate the electrically driven trawling winch, and a 15 hp. Colo Diesel that operates a 10 kw. generator for lights. Her speed is nine knots.

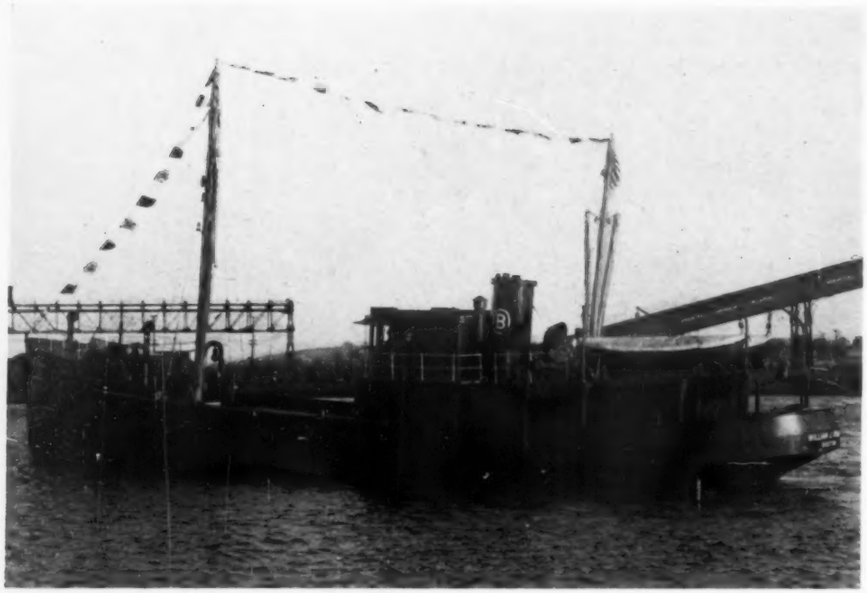
It did not take long to prove to O'Brien & Co. that Diesel trawlers were more profitable than operating on shares in other vessels, so

T 25% LESS





Upper left—one of the 360 hp. Nelseco Diesels used in each of six sisterships.
Upper right—the DORCHESTER. Below—the THOMAS WHALEN.



The WILLIAM J. O'BRIEN, largest of the fleet.

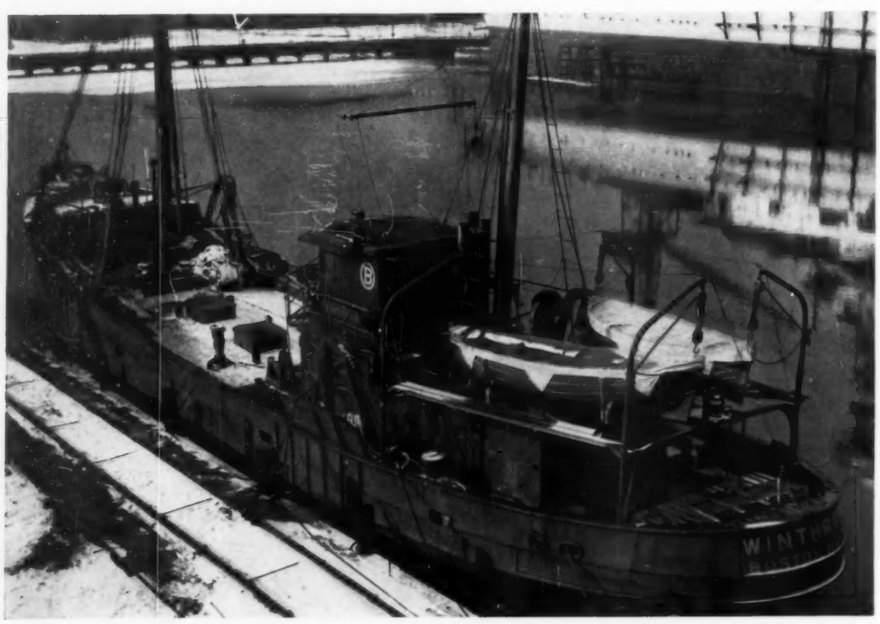
a year later, in 1929 an order was placed with the Bethlehem Shipbuilding Corporation's Fore River plant for three 110-footers. "Let's standardize now" said the company officials, "and save money."

Built from a single design and alike in every detail, the three 110-foot steel trawlers were all powered with mechanical injection 6-cylinder Nelseco Diesels of 350 hp. at 280 rpm.

For trawling work the engines are geared to a McKinney clutch with power transmitted by a vertical shaft. Thus, a single engine operates the trawl winch as well as propels the vessel. It also furnishes power to operate one of the two air compressors, the second compressor being driven by a 10 hp. Colo Diesel, the latter used for a generator to supply light.

At trawling speeds the engine operates at 210 rpm. These three ships, the QUINCY, WINTHROP and DORCHESTER, have a maximum speed of ten knots. Fuel consumption averages 15½ gallons an hour, burning 28-32 gravity fuel oil.

The WINTHROP tied up at her dock.



In 1931 an opportune purchase resulted in the adding of a wooden ship, the HELEN M., bought at auction. She was built in 1925 at Damariscotta, Maine. Eighty-one feet in length, she is the smallest of the O'Brien fleet, though is likewise Diesel powered. Her main engine is a 180 hp. Fairbanks Morse. Her trawling winch is operated by an auxiliary engine, a 60 hp. Bessemer Diesel. In addition she carries a small 5 hp. Lister Diesel to operate a generator set furnishing 32-volt current for lights and general utility purposes. Her speed is nine knots.

Last year the owners duplicated its order of five years previous and three more 110-footers with the same specifications and engines came off the ways at Fore River, the THOMAS WHALEN, PLYMOUTH and ATLANTIC.

These brought the total number up to eight, the largest Diesel tonnage of any fishing fleet operating out of Boston. Incidentally R. O'Brien & Co. was the only operator in New England to build any new ships during the past four years.

The O'Brien fleet's port engineer, Arvid G. Ohlin, knows ships and marine engines. He's been all over the world in them. For nineteen years he served the New London Ship & Engine Company as machinist and later tester and guarantee engineer, before he joined R. O'Brien & Co., five years ago. Standardization is an axiom with him.

"We figure our operating costs with Diesels is at least 25 per cent less than it would be with steam," says Ohlin. "Our savings come first, in fuel; second, in reduced personnel; and third, in hull investment. For equivalent fish storage we'd need ships ten feet longer if they were steam vessels of the same speed. Smaller engine room space with Diesel engines allows us more fish holds. If we used steam there'd be more space taken up with boilers, feed water tanks and coal bunkers."

"Another thing – with steam power a ship of this size would need an engine room crew of five – two engineers and three firemen. All we need is two – chief and second engineer, dividing the watches."

"Standardization works another economy be-

. . . . . *And now please turn to page 44*

Sterling MOTOR TRUCKS DIESEL

42 Sterling-Diesels in One Fleet

You can't meet Diesel competition with gasoline equipment. Here is why—

- **Fuel Costs** from ½¢ to 1¢ a mile
- **Less Time on Road —** Diesel torque characteristics result in less gear shifting and also higher road speeds on grades and heavy pulls
- **Lower Operating Costs—**Because of simplicity of Diesel engine. Minimum gear shifting reduces maintenance — reduces loss of operating time — and reduces fuel consumption tremendously
- **Sterling-Diesel Economy and Superiority** proven by millions of miles of actual service during the past 2½ years.

STERLING MOTOR TRUCK CO., INC.
MILWAUKEE, WISCONSIN

Sterling-Diesels are making heavy duty gasoline trucks obsolete because of more than 75% fuel savings along with lower maintenance resulting in *tremendously reduced ton-mile costs!*

Mail this Coupon Today

STERLING MOTOR TRUCK CO., Inc.
Milwaukee, Wis.

Please tell me how much Diesel powered trucks will save me compared with Gasoline units under the following operating conditions.....

I operate.....Trucks, ranging from.....tons to .....tons capacity.

Name.....

Address.....

City.....*State*.....

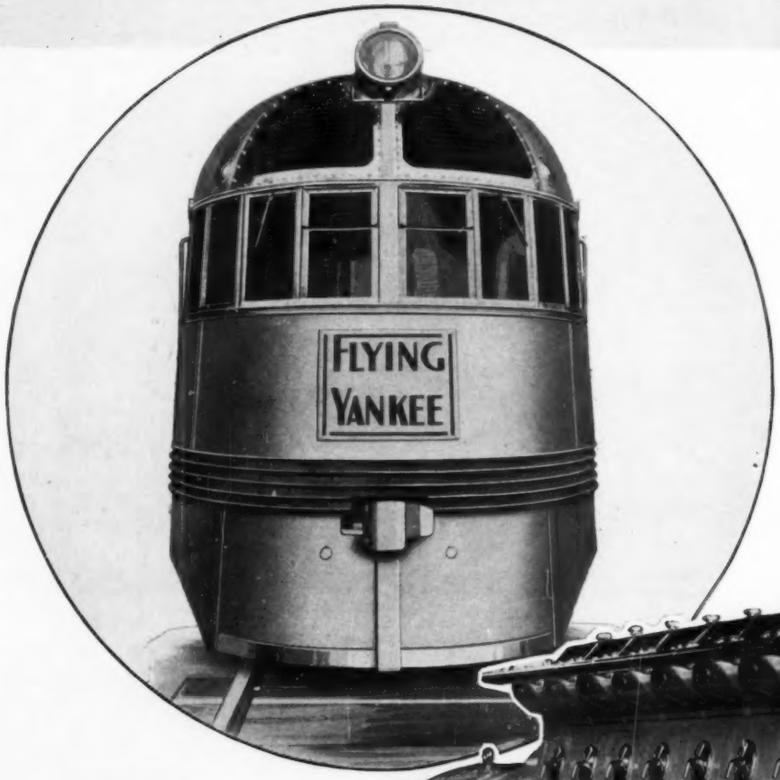
Interested in your motor replacement plan Diesel ☐ Gasoline ☐

Make of motor to be replaced.....

Engine Model No. .....

Bore and Stroke.....

"The Pioneer of the Diesel Truck"



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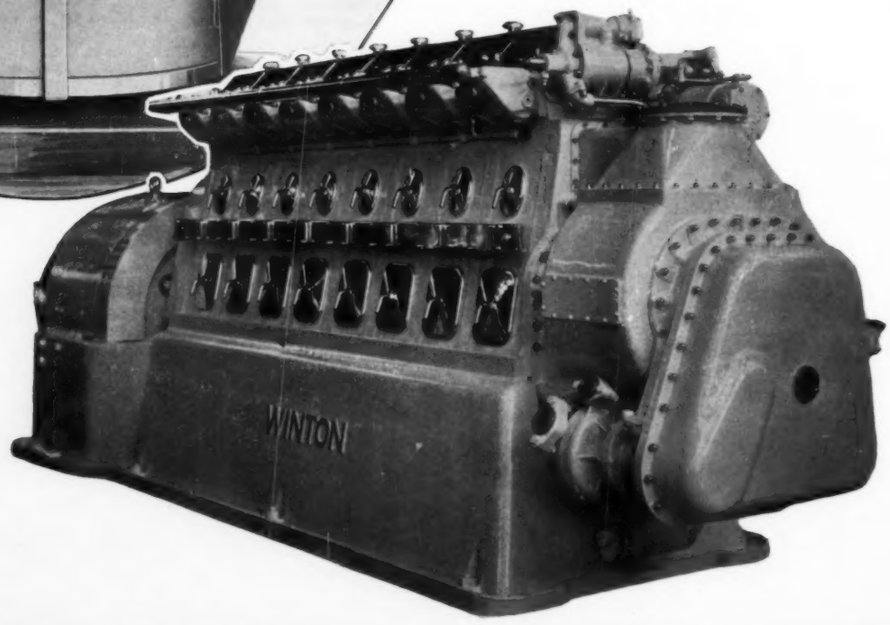
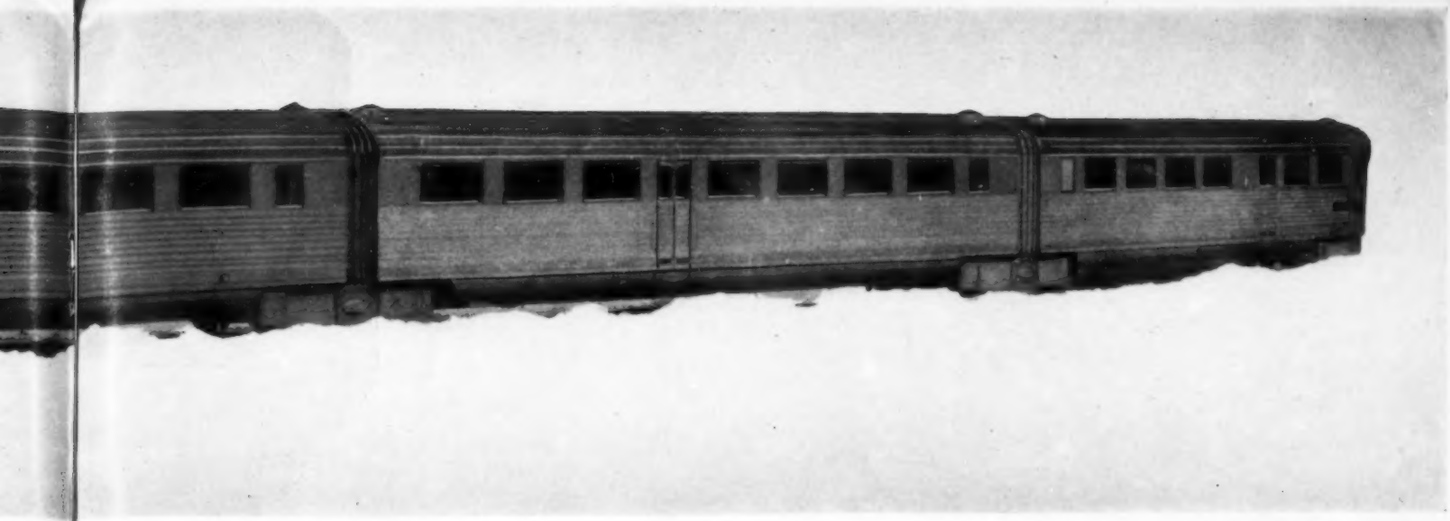


Symbol of Economy
and Dependability

The new train is powered with this 600 h. p. Winton-Diesel engine. Revolutionary advances embodied in this power plant promise to revitalize America's transportation systems

POWERED B



Flying Yankee

. . . . . THE LATEST SYMBOL OF NEW ENGLAND PROGRESSIVENESS

AGAIN, staunch New England progressiveness plays an important role in the advancement of railroad history . . . and again the Maine Central and Boston & Maine Railroads carry on to add another "first" to their long line of outstanding achievements. The *Flying Yankee* is the first stainless steel, high-speed, articulated, streamlined passenger train to be put into regular operation in the East. Always alert to the advancement of better service as well as to the comfort and safety of passengers, the executives of these important lines are to be commended for their farsightedness and sympathetic vision of the needs and demands of the traveling public. The *Flying Yankee*, epitomizing the ultimate in modern railroad transportation facilities, is powered by a two-cycle Winton-Diesel engine embodying many advanced engineering features, including greater compactness and reduced weight per horse power. The Winton organization joins the railroad world in hailing the accomplishments of the *Flying Yankee*, New England's first high-speed Diesel train.

WINTON ENGINE CORPORATION
CLEVELAND, OHIO U. S. A.

BY WINTON

ERIE FORGE COMPANY

ERIE PENNSYLVANIA

WE manufacture a majority of the Diesel engine crankshafts used in the United States.

The big, dominating factors in the Diesel Engine industry have for a number of years relied on us for their crankshaft and Diesel engine forgings.

We believe their confidence has not been misplaced.

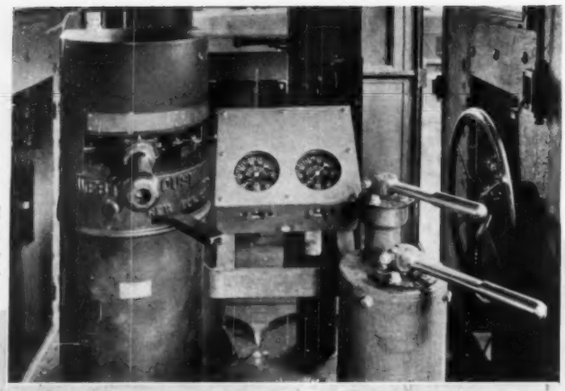
Rough and Finished Forgings—Steel Castings

IN THE FORESTS AND ON THE LEVEES

Right—A Model "L.O." Allis-Chalmers Diesel tractor coming down a skid road with a big load of logs in southern Oregon. This tractor must operate on grades of 65 to 70%. Its fuel consumption is $1.96 a day.

Below—Four of the six "Caterpillar" Diesel Seventy-Five tractors operating on a levee construction job at Stovall, Miss. They are hauling two 10-12 yard La Plant-Choate bottom dump wagons from 2-yard shovels. Averaging 6,000 yards, daily with the six tractors and twelve wagons; the haul ranging from 1,000 feet up.

RAILROAD ECONOMIES



Concentrated arrangement of engineman's controls.

800 hp. Westinghouse Diesel electric locomotive of Northampton & Bath R. R.

New York Central's Diesel electric locomotive equipped with an Ingersoll Rand 750 hp. engine.

RAILROAD operators are finding that the Diesel engine not only solves the problem of high speed passenger service on streamlined articulated trains, but also the more prosaic service in the yards performed by the switching engines. Large industrial concerns have also adopted the Diesel engine as the most economical means for supplying power for switching operations in the plant yards. Diesel switchers can lie idle in the yards for various lengths of time without the need for keeping the fires banked and may be started immediately when there is a switching job to be done.

From data gathered by the American Electric Railway Association and the American Railway Association, comparative figures between steam locomotive operation and Diesel locomotive operation provide conclusive evidence of the economy of the Diesel. Figuring oil for Diesel locomotives at 5c per gallon and coal for steam locomotives at $3.00 per ton, a saving of approximately 75 per cent per 100 ton-hours is shown for Diesel fuel costs over steam fuel costs. For switching service it takes 140 lbs. of coal to produce power equivalent to that of one gallon of fuel oil. Lubrication costs for Diesel engines run approximately 8.76c per 100 ton-hours for switching service, while the cost for "other lubrication" on Diesel locomotives is about 35 per cent less than steam. In general, considering the total of all costs for fuel, for lubricating oil for both the Diesel engine and the locomotive, and including "other expenses," the operating costs of Diesel locomotives is found to be 33 per cent of the corresponding costs of steam locomotives.

With stronger competition from motor transportation and with increased steam operating costs, progressive railroad officials are turning to Diesel engines to solve their problems of reducing operating costs for both high speed passenger service and switching service.

OLD MAN RIVER

Can now boast of the most modern Towboat government owned and of course Diesel powered.

THE ROBERT E. LEE – famous in song and story of the Mississippi's glamorous steamboat days – bids fair to have a rival for fame. And this by a towboat! A 1935 creation that is the last word in efficiency and appearance.

No high twin stacks belching forth the clouds of black smoke and sparks which everyone seems to associate with a Mississippi River boat but a trim, clean cut, smokeless craft in jet black and glistening white. A twin-screw Diesel powered vessel symbolizing a new era in design and powering of modern river craft.

The "COINER," as this new towboat is named, was recently completed for the U. S. Engineers. It will be used in general towing service in the Vicksburg, Miss., district. It is the largest and most powerful tugboat placed in service by the U. S. Engineers up to this time. It is probably the largest towboat ever launched for use in our inland waterways. The principal dimensions are:

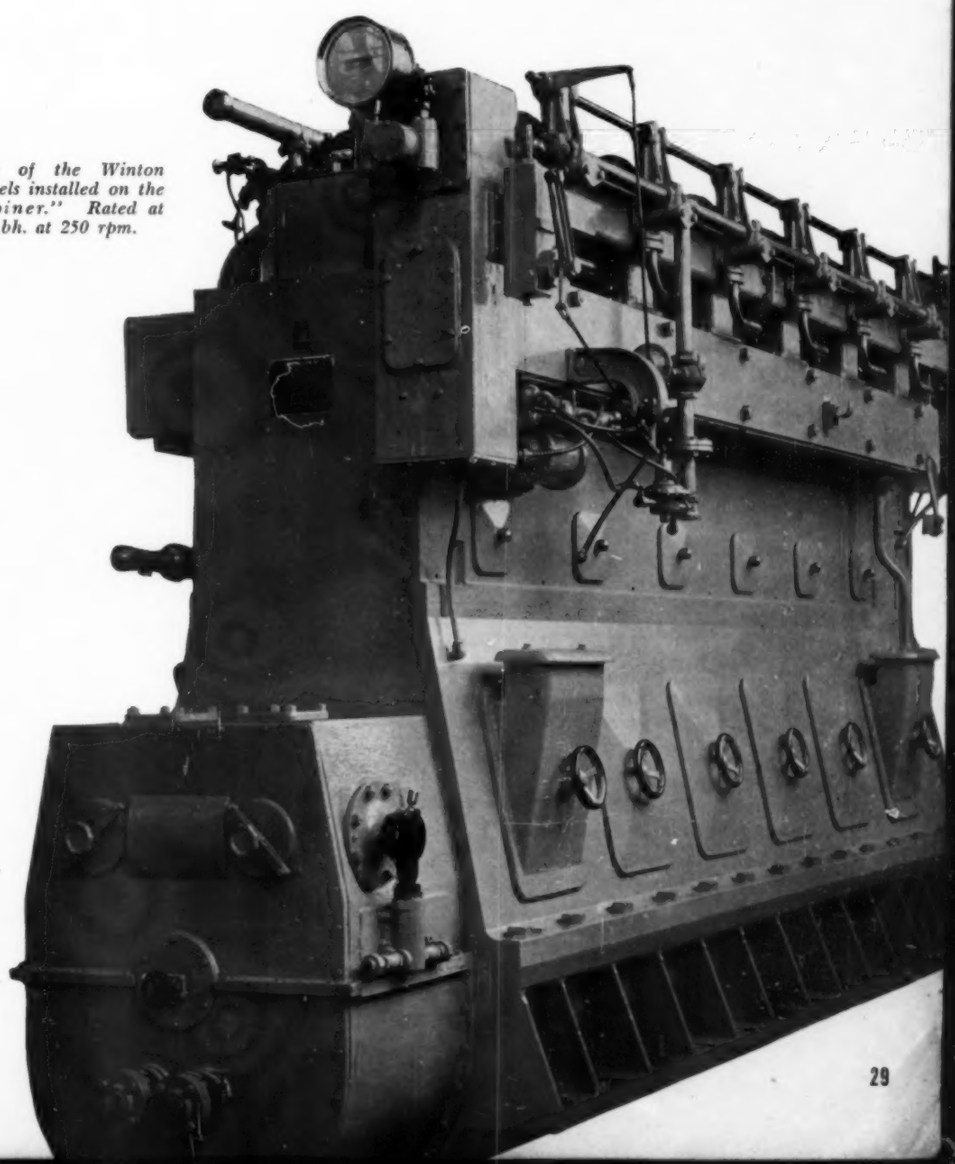
Length, molded	176′–0″
Length overall	177′–3¼″
Breadth hull, molded	38′–0″
Breadth overall	38′–9⅛″
Depth, molded	8′–6″
Draft	5′–2″

The "COINER" was designed in the Marine Design Division, Office Chief of Engineers, Washington, D. C., under the supervision of Captain Elliott Vandervanter, U. S. A. It was built by The Marietta Mfg. Co., Point Pleasant. West Virginia, and given a trial run in the Ohio River on March 25th, during which more than full expectations were realized.

The entire hull is built out of genuine wrought iron plate. Longitudinal bulkheads are provided the full length of hull 11′–6″ from center line on port and starboard sides, and are oil-tight in way of oil bunkers, and water-tight from the aft to forward compartment. A number of water-tight transverse bulkheads are provided for the safety of the vessel. A notable feature is the arrangement of main deck in engine room. The conventional way is to cut the main deck and leave a wide opening the length of main engines from the longitudinal bulkheads; the center or inside bulkheads are also cut to the floor. Here the center bulkhead is carried the full depth of the hull clear through the engine room.

The main deck also is extended the whole length of engine room, and openings are cut only to allow the main engines to protrude through these openings, with some margins to allow for any dismantling of the engines, and for removal of auxiliary machinery installed below deck. Removable subway gratings are fitted close to the engines. Access to lower engine room is aft of engines, with emergency exits at forward end of each engine.

The main deck house is built of steel. The upper deck house and pilot house are of wood.



One of the Winton Diesels installed on the "Coiner." Rated at 650 bh. at 250 rpm.

The Towboat "Coiner."

A unique feature in this towboat is the location and arrangement of the engine room crew, which is on the main deck just forward of the engine room. Oilers' and wipers' quarters, with showers and toilets between, are separated from the engineers' by a transverse passageway. The chief engineer's quarters is fitted with individual shower and toilet. The remaining engineers' quarters are arranged with shower and toilet between. This arrangement is conducive to better efficiency due to this crew being near the engine room and all grouped together.

The Marietta Manufacturing Company selected Diesel engines manufactured by the Winton Engine Corporation, Cleveland, Ohio, as being the most suitable ones for this boat. The main engines are rated 650 bh. at 250 rpm. direct reversible. On the test block these engines developed 826 bh. at 250 rpm., and could have done even better than that had the water brakes been able to absorb more hp.

Extreme care was taken to calculate beforehand the torsional vibration. This is a customary precaution with the U. S. Engineers on all of their installations. The result, therefore, is that the engines can be operated in their entire speed range with a total absence of vibration usually encountered in a good many installations, where this most important requirement is neglected.

Each engine swings a 7-foot propeller of special design to give the boat the best possible towing quality. The thrust bearings are manufactured by the Kingsbury Company. Instead of placing the thrust block next to the engine, the thrust is some 17 feet away from the engine, so that only torque and no thrust is transmitted through the line shaft. The stern tubes and struts are provided with Goodrich rubber bearings.

There are two Diesel generating sets, each having a capacity of 75 kw., operating at 750 rpm. To avoid vibration 6-cylinder units were selected. For week-end service there is a 15 kw. Diesel generating set operating at 600 rpm. All 3 generating sets were manufactured by the Winton Engine Corporation. Each of above engines has attached lubricating oil pumps. The generating set engines have also attached circulating water pump.

As clearly shown in pictures, there is a specially designed control stand, to our knowledge the first of its kind, mounted on the main deck between the main engines. One operator can easily operate both engines. One lever for each engine to reverse its engine can be manipulated by the operator at the same time. The other two levers are for speed control.

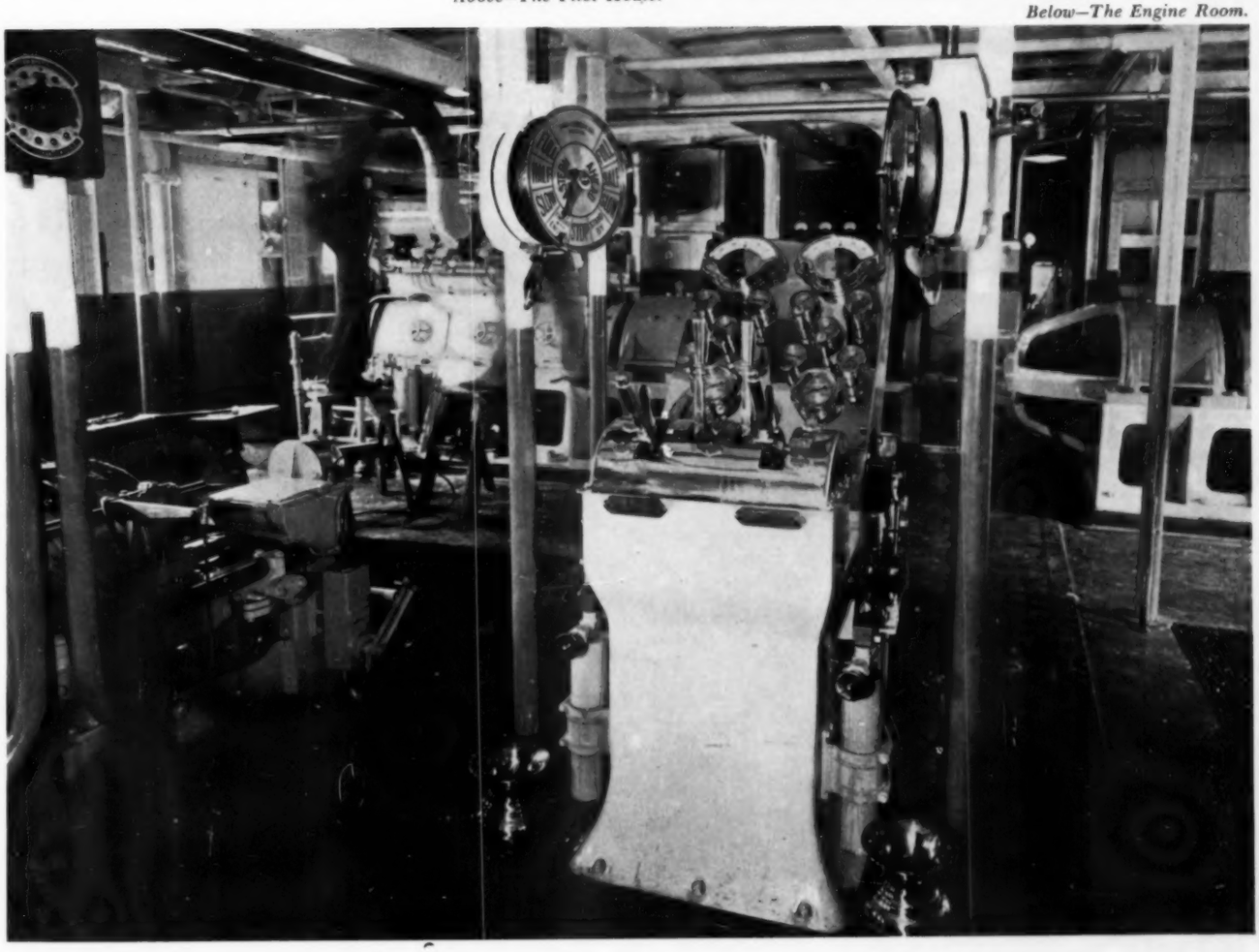
In back of operating stand are all necessary gauges mounted in plain view of the operator. On each side of operating stand are the engine room telegraphs. A pyrometer is mounted close by on the left of operating stand, within reach of the operator. This pyrometer serves both main engines. The Winton Engine Corporation is to be complimented for their spirit of cooperating in developing this operating stand to the wishes of the Department.

The engines are water cooled with fresh water. A 2500-gallon cooling water tank is provided. Also two fresh water coolers, each serving one main engine and one 75 kw. generating set. The coolers are of extreme liberal capacity to take care of reduction in transfer efficiency due to scale forming and also that both main engines may be operated on one cooler at about ¾ speed; should it become necessary to clean one cooler by the crew, the vessel would not be out of commission.

The oil coolers use fresh water only to cool the lubricating oil. Sea water is circulated through the fresh water coolers overboard. A weighted check is attached to side of hull to maintain a discharge pressure of 12 pounds. A branch line is installed ahead of this check valve to each stern tube. No valves are provided in this line except a cock at the stern tube which normally remains open. This assures a positive means of supplying water to the rubber bearings automatically whenever the engineers start their main engine.

Above—The Pilot House.

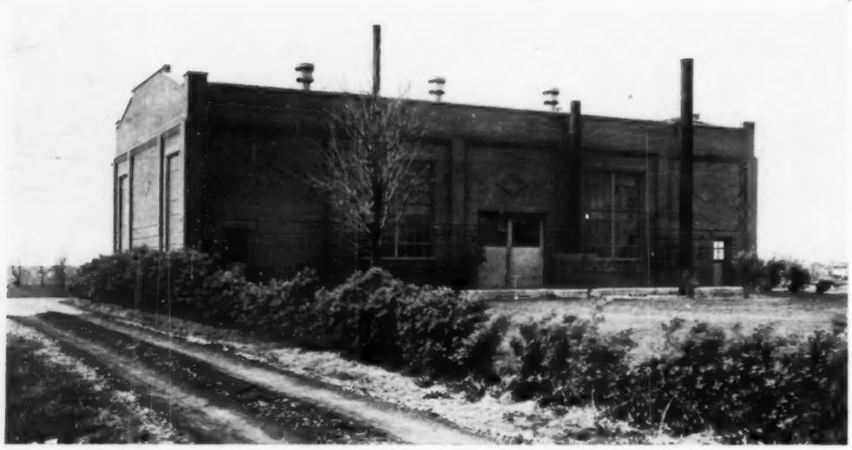
Below—The Engine Room.



IN AUGUSTA, KANSAS

The addition of one small unit improved fuel economy approximately 25 per cent.

By DR. F. A. GARVIN
Mayor, Augusta, Kansas



Augusta's power plant.

ABOUT the year 1910 or 1911 a druggist in Augusta wanted electric lights for his store. As there was no power line in this section of Kansas, he installed for his private use in a back room in his store, a 25 hp. gas engine and connected it up with a dc. generator. Having some surplus current, he sold electricity to his merchant neighbors on each side. Very shortly the demand reached a point where he could not supply it with his back room plant and he came before the governing body with a request for a franchise. After considering the matter at some length, they finally decided to refuse this request but to embark in the electric business as a municipality.

The city then started the municipal plant in 1913 by installing engines at the city water plant and building a distribution system. This was done without the issuance of any bonds and this precedent has been followed consistently—the light plant has always paid its own way. This original plant comprised three gas-engine units, one 100 hp., one 200 hp., and one 280 hp.—all purchased second-hand. These units served the city from 1913 until 1918, when the growth in population on account of an oil boom required a more efficient plant.

In 1918, the electric plant was enlarged and two unaflow engine-generators were installed. These engines were 300 hp., each, and the generators 250 kw., each. The steam plant was carrying an overload much of the time. In 1928, the city council was considering the matter of purchasing a Diesel engine as an auxiliary when the plant was flooded during the month of November and the city was obliged to hook on to the Kansas Gas & Electric Company power line for about two weeks. To prevent the recurrence of further high water trouble, it was decided to erect a new plant on higher ground and to make the entire plant Diesel, discontinuing the use of the steam plant.

As no funds were available for the expansion, bids were asked for the installation on the extended payment plan and the contract eventually given to Fairbanks-Morse & Company for two 540 hp. engines, direct-connected to two 376 kw. alternators.

The payments were set at $1292.54 per month with interest at 6 per cent and extended to March 1935. It was figured this monthly payment would represent the saving in operating cost of the new Diesel plant over the steam plant. As a matter of fact it was found that the saving was much more than this, and meeting our payments promptly we were still able to accumulate an Electric Extension Fund for future needs at the rate of $500 per month.

A rather interesting feature of the cost of steam stand-by to Diesel was observed during the first month of operation of the new Diesel plant. It was decided to keep the boilers of the steam plant hot to insure adequate stand-by. The cost of doing this was a $1200 gas bill as compared to a maximum gas bill of $2200 when the entire steam plant was in operation; consequently, no dependence was placed on the steam plant thereafter.

In 1933, the load conditions at the plant were not favorable to the 376 kw. units, as the daily peak load averaged 420 kw., with the off-peak load falling in the small hours of the night to as low as 70 kw. This meant that both units must be used during the peak hours, giving us a load factor of little over 50 per cent; while for six or eight hours at night the load fell to but little more than 25 per cent of the capacity of one unit.

As the Electric Extension Fund had grown to $18,000, it was deemed advisable to increase the capacity of the plant by the addition of a unit of approximately half the size of the existing units. Application was made to the P.W.A. for a grant to cover 30 per cent of the cost, the balance of the purchase price to be taken from the cash in the Electric Extension Fund.

Bids were received and the contract awarded, in December 1933, for an Atlas Imperial Diesel Engine direct-connected to a 175 kw. Elliott Generator. This unit was installed and put into operation in April 1934. An immediate improvement was observed in operating costs due to the use of the new unit, which is becoming more marked as time goes on.

The Atlas-Elliott unit is used at all times except when the plant load falls between 200 kw. and 350 kw., at which times one of the F-M 376 kw. units is run alone. For larger loads than this the new unit is also thrown

Dr. F. A. Garvin, author of this article, was a member of the City Council of Augusta from 1927 to 1929. He ran for mayor in 1929, and was unopposed. He is completing his third term this year, but maintains that he is not going to be a candidate for re-election.

Improvements which have been made during Dr. Garvin's administration consist of a water impounding project, totaling $130,000, and the Diesel engine plant, which totals over $125,000, exclusive of the distribution system.

The City of Augusta is to be congratulated on the excellent operating record of their electric plant, and Dr. Garvin is to be complimented on the excellence and completeness of his records of plant operation. The care taken by Dr. Garvin and Mr. R. M. Book, City Clerk, in arriving at a scientific new schedule of electric rates should be a helpful example to others contemplating revised schedules.

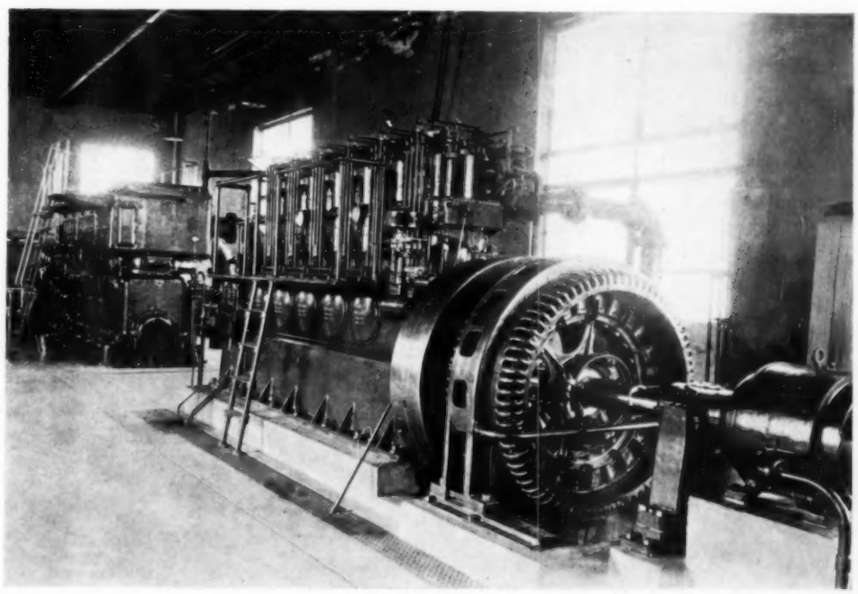
on the line. The daily hours of operation of the new unit probably averages 10 out of 24.

The record of generation for the past few years follows:

Year Ending April 15	Kw.-Hr. Generated per Gal. Fuel Oil	Kw.-Hr. Generated per Gal. Lube Oil
1932	8.32	479
1933	7.88	596
1934	7.57	654
*1935	9.38	990

*9 months ending January 15, 1935.

It will be observed that the use of the new unit has effected savings in fuel of 19 per cent over 1933, or 25 per cent over 1934, and savings in lubricating oil of 68 per cent and 51 per cent respectively. Due to an increasing attentiveness on the part of the operators to secure maximum utilization of the new unit, we find the average kilowatt-hours generated per gallon of fuel oil for the past two months is 9.7, indicating that the plant record for a complete year of new unit operation will be close to 10 kilowatt-hours per gallon. The new unit then must be credited with a reduction in plant fuel consumption of approximately 25 per cent, a saving in plant lubricating oil of approximately 50 per cent, and it gives us stand-by of one large unit at all times, thus reducing machine maintenance and repairs at least 25 per cent.



Engine room with Atlas Diesel and Elliott generator in foreground. Fairbanks-Morse Diesel in background.

The total city tax levy is 7 mills. It would require more than double this levy to pay the interest and meet the retirement program on the outstanding general obligation bonds were it not for the fact that the remainder is paid from the utility funds. The Electric Extension Fund, mentioned above, was sufficient to pay off the payments on the original Diesel engines of approximately $16,000 per year, and the last payment will be made March 1, 1935. It was decided last year to give the light consumer an additional share of the profits from the operations of the electric plant. This was possible because of the approaching end of the period during which time we were still paying for the original Diesel engines. The existing rates were as follows:

LIGHTING

First	50 kw.-hr.	@ 7c
Next	50 kw.-hr.	@ 6c
Next	150 kw.-hr.	@ 5c
Next	250 kw.-hr.	@ 4c
All over		@ 3c

POWER

First	1000 kw.-hr.	@ 4c
All over		@ 3c

Various proposed new rates were checked over, and existing rate structures for other cities were studied carefully. Knowing exactly how much we would be in a position to return to the people at the expiration of the period of payments on our original Diesel investment, revenues were figured for all customers at the old rate and at several proposed new rates and a final new rate selected, which, when figured for the total customers showed a saving of $16,000 per year or approximately 33 per cent. These rates are as follows:

SOLITARY LIGHTING AND POWER RATE

First	20 kw.-hr.	@ 5c
Next	80 kw.-hr.	@ 4c
Next	3000 kw.-hr.	@ 3c
Next	3000 kw.-hr.	@ 2c
All excess		@ 1c

Minimum for any meter $1.00 per month, or power customers hp. minimum 25c per hp.

COOK STOVE RATE

3c per kw.-hr. straight.
Minimum $2.50 per month.

LIGHTING THE AIRWAYS TO THE ORIENT

Pan-American Airways select Caterpillar Diesels to furnish power for airport lighting on new route to the Orient.

THE Diesel engine will play an all-important role in the establishment and successful operation of the Trans-Pacific air route sponsored by Pan-American Airways. The 6,000-mile route will be opened this summer, with Col. Charles A. Lindbergh taking an active part in the founding and maintaining of the service.

Giant Martin planes, each having four Wasp engines developing a total of 3,200 horsepower and capable of hauling 53 passengers, will fly the route. San Francisco and Hong Kong, China, are termini, with stops to be made at Honolulu, Midway, Wake, Guam, and the Philippine Islands. Equipment and supplies are pouring into San Francisco. A chartered ship transported these and a corps of workers to distant points on the route. Departure was on March 15.

Four "Caterpillar" Diesel Power Units and two Diesel tractors have been purchased by the Airways company for use on Midway and Wake Islands, two stops on the new route. The Midway Island group is about 1,000 miles northwest of the Hawaiian Islands, with Wake Island another 1,000 miles westward. Landing fields will be built and maintained at both of these tiny coral-reefed strands. Here the mammoth airliners will be groomed, refueled and lubricated before proceeding on to the next distant stop.

Two Diesel units and one tractor will be placed on each island. The units, equipped with General Electric generators, will supply power for beacons, landing and border lights. They will also provide electricity for refrigeration and lights for the attendants and mechanics' field houses. The tractors, equipped with single drum winches, will level and maintain the fields, and be used for general utility work.

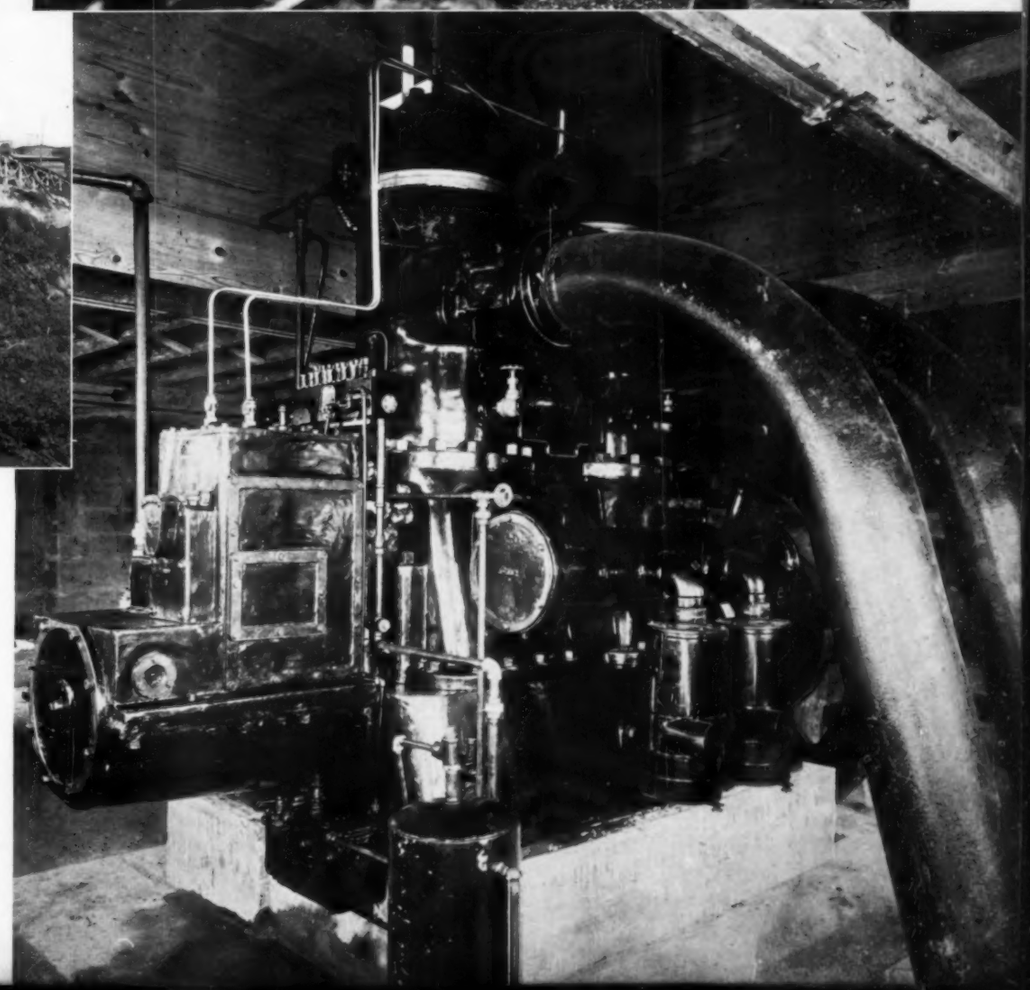
Pan-American officials selected the Diesel after exhaustive study and test. They knew the lives of their passengers, their crack pilots, and the success of the project depended upon a system of airways lighting that was fool-proof and reliable. Diesel power units and tractors, operating day in and day out in isolated regions throughout the world, had proved their worth and their ability to "take it." They gave the maximum and required a minimum of fuel cost. They were rugged and their parts interchangeable with "Caterpillar" Diesel Tractors working on the same job.

And so the Airways experts picked the Diesel. They went one step further with Diesel's economy and plan to operate these engines at NO fuel cost. Crankcase drainings from the big planes will be placed in centrifuges, carbon and grit removed, and poured in the Diesel units' fuel tanks. More than 400 gallons of this discarded lubricating oil will be available each week, and this, with the addition of the Diesel's own crankcase drainings, will be an adequate supply for the engines.

DIESEL IN CENTRAL OHIO QUARRY

By G. V. R. MULLIGAN

THE Kuenzli Quarries Company installed a two cylinder Victor Diesel in their Upper Sandusky, Ohio plant early in 1933. They have now, as a background, two seasons of operation, and the results have been very satisfactory, not only accomplishing the desired reduction in operating expenses but also eliminating stand-by charges, formerly charged them by the utility company, during periods when orders were spotty and operations curtailed. The Diesel was there when needed but used no fuel or lubricating oil when the plant was shut down.



General views of the Kuenzli Quarries and the Victor Diesel.

The crushers and conveyors in this quarry are belt driven from line shaft direct connected to the engine, and a small generator, also belt driven from the engine, supplies current for all auxiliaries. This Diesel installation is but another typical example of how the economy and dependability of the Diesel engine can be applied to present economic conditions.

OIL FROM THE DESERT

Transporting 4,400 ton miles of oil per minute. This modern engineering triumph has been made possible by the use of 22,500 hp. of Diesel engines.

TWENTY centuries and more ago local mineral oil was used for the temple fires of an ancient civilization bordering the Syrian desert.

To-day, strange as it may seem, oil from these same fields is used as a means of lighting modern temples thousands of miles away. And the same oil drives wagons, ships, supplies heat, and practically transports itself to the seacoast.

The agency that makes possible the use of this ancient oil supply is the modern Diesel engine. No romance ever penned is so full of the fanciful as is this modern engineering achievement, bringing oil from the wells at Kirkuk in Iraq, Asia, to the Mediterranean seacoast at Tripoli, 532 miles away, and at Haifa, 451 miles from the starting point.

The oil is transported through two steel pipe lines with a total length of 1217 miles. 1012 miles consist of 12″, 191 miles of 10″ and 14 miles of 8″.

The oil is pumped through the pipe lines, and the fuel used for the power to do this pumping is the oil itself—through the agency of Diesel engines locate in the pumping stations.

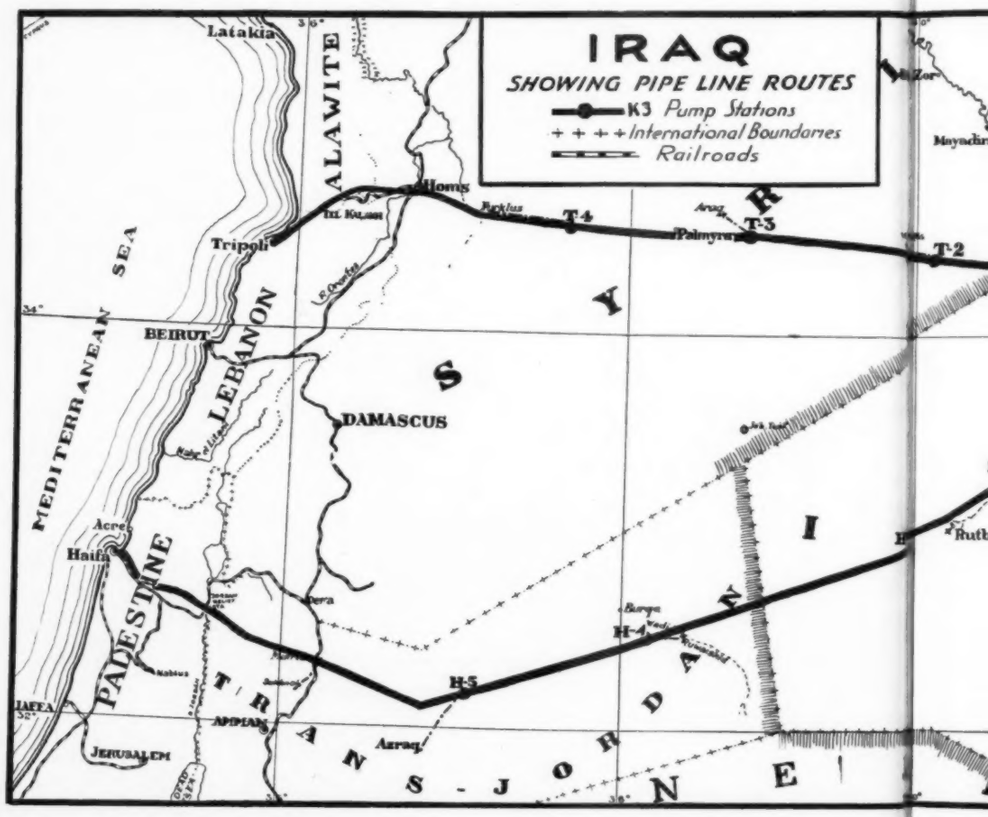
The reason for pipes of three diameters being used is due to the topography of the country crossed by the pipe lines. The 12″ pipe is used for the long stretches between pumping stations, and the 10″ is used near the pumping stations; and the 8″ is used to reduce the gravity pressure on the sharp descent into the Jordan valley on the line leading to Haifa.

The development of the oil fields of Iraq is a joint international effort by American, British, Dutch and French oil interests. During the Great War, these nations were deeply impressed by the dependence of military and particularly of naval operations upon liquid fuel. Participation in the development of these oil fields was made a subject of special agreement between Great Britain and France and later included American interests. The Iraq Petroleum Company, Ltd., as finally constituted, became a British company with Sir John Cadman, distinguished leader of the British petroleum industry, as its chairman.

Ever since 1928 when the Iraq Petroleum Company met with phenomenal success in their sinking of the well-known Baba Gurgur No. 1 well, the main efforts of the company has been directed towards negotiating a new concession from the government of Iraq, which was obtained in 1931. The company then undertook to construct a pipe line from Kirkuk to Haditha and thence by two separate lines to Tripopli and Haifa on the Mediterranean Sea.

Under this new concession, the development of 30,000 square miles of oil lands was granted to the company. A start was made in the summer of 1932 and so rapidly did the work of constructing the pipe lines progress that the line from Kirkuk to Haditha and Tripoli was completed by August 1931, and the line from Haditha to Haifa opened three months later.

To propel 3,000,000 tons of oil per year over these pipe lines, which total 1,150 miles in length, requires 22,500 available hp. This power is supplied by 45 Diesel engines located at twelve main pumping stations, three on the double line between Kirkuk and Haditha, four



on the northern line between Haditha and Haifa. As fuel these engines use oil taken directly from the pipe line.

The various concerns supplying Diesel engines for this pumping operation are indicative of the international character of the Iraq development. Solid-injection engines of 500 hp., 5 cylinder, 4 cycle, Sulzer design operate along the double pipe line. Nine of these were built by the British house of Sulzer Bros. and nine by the Compagnie de Construction Mechanique Precedes Sulzer, Paris. Harland & Wolff, Ltd., supplied fifteen 500 hp., 6 cylinder, 4 cycle solid injection engines for the southern line. While on the northern line, twelve engines of 500 hp., 5 cylinder, 4 cycle solid injection type were installed by Werkspoor Co.

The Sulzer engines are of 365 mm. bore by 550 mm. stroke and have a rating of 500 bhp. at 300 rpm. One piece of special iron is used for casting the five cylinders and upper part of the crankcase. In this rigid box frame are fitted five interchangeable cylinder liners.

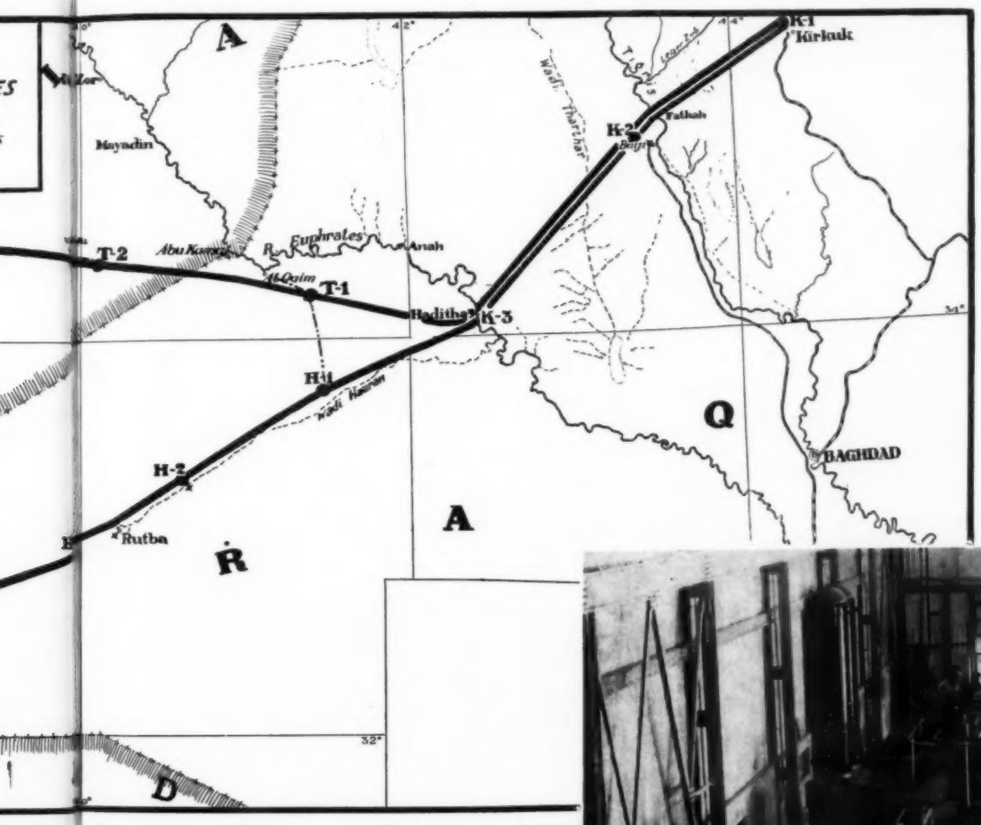
The bedplate carries the six main bearings which are lined with white metal. Single forgings of open hearth steel are used for the crankshafts, while the pistons are made of special iron cast in one piece with bosses to carry the gudgeon pin. Connecting rods are solid steel forgings. Mechanically operated inlet and exhaust valves and an automatic fuel valve are located in the cast iron cylinder heads.

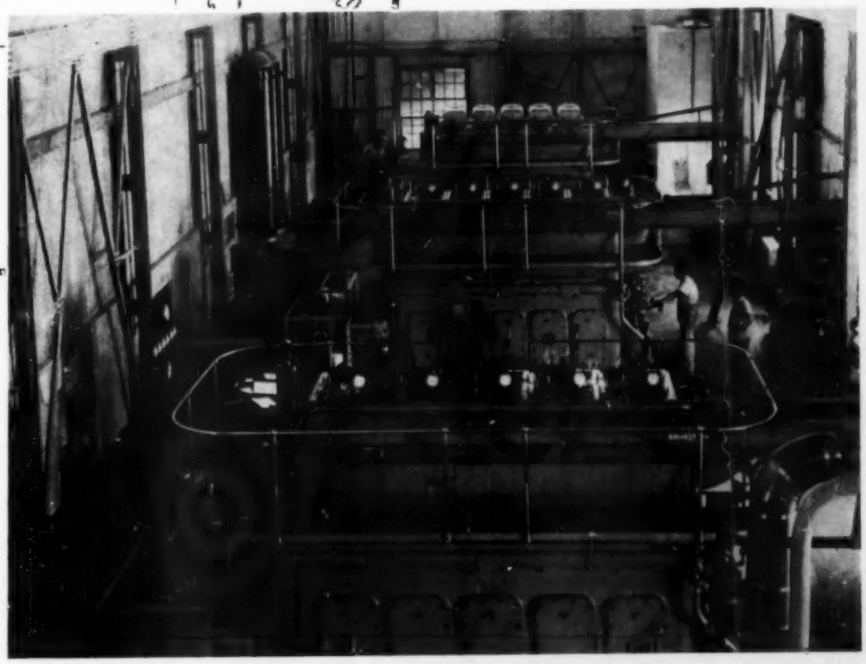
The Harland & Wolff engines have six cylinders of 330 mm. bore and 580 mm. stroke. In these engines, the combined crankcase and cylinder jacket is a monobloc casting. Recessed into the frame are the cylinder liners of special cast iron. Circular type cylinder covers with combustion chamber dished inward relieve temperature stresses. Exhaust valve heads are made of special steel, and both exhaust and inlet valves operate by push rods and levers.

The Werkspoor engines are of the regulation T. M. type, with five cylinders, 350 mm. bore by 580 mm. stroke, developing 500 hp. at 300 rpm. Trunk pistons are used without piston cooling, and Bosch fuel pumps provide airless fuel injection. The U shaped crank casting of the engine is made of cast iron. On this casting is mounted a box shaped beam containing the cylinder liners and forming a cooling water jacket. A case containing the camshaft is cast onto the lower part of the cylinder beam.

In this engine, the fuel cam is also the starting cam. A simple cylinder and plunger above the starting air valve is actuated by the pressure of fuel from the fuel pump when starting. This opens the starting air valve against a spring, and allows the air to enter the cylinder.

On January 14, when King Ghazi of Iraq started the Diesel engines turning in stations K-1 at Kirkuk he began a new chapter in the development of the petroleum industry in the Near East. Now that Persia and Iraq have taken the lead, others will undoubtedly follow. This first great line of steel pipe with Diesel and pumping equipment that carries its valuable cargo across the desert may be only the forerunner of many more lines to come.





PROGRESS

THAT the Diesel engine industry may well be proud of its record of recovery from the depression of the past four years is shown by the chart. After reaching a high peak of 450,000 hp. sold in 1928, the two following years showed a slight decrease in production, but it was not until 1931 that the total amount of horsepower sold started to decrease rapidly. This precipitous decline continued during 1932 and reached its low level of 130,000 hp. sold during that year. At that point the Diesel engine industry stood, as far as sales go, just about where it was at the end of the World War.

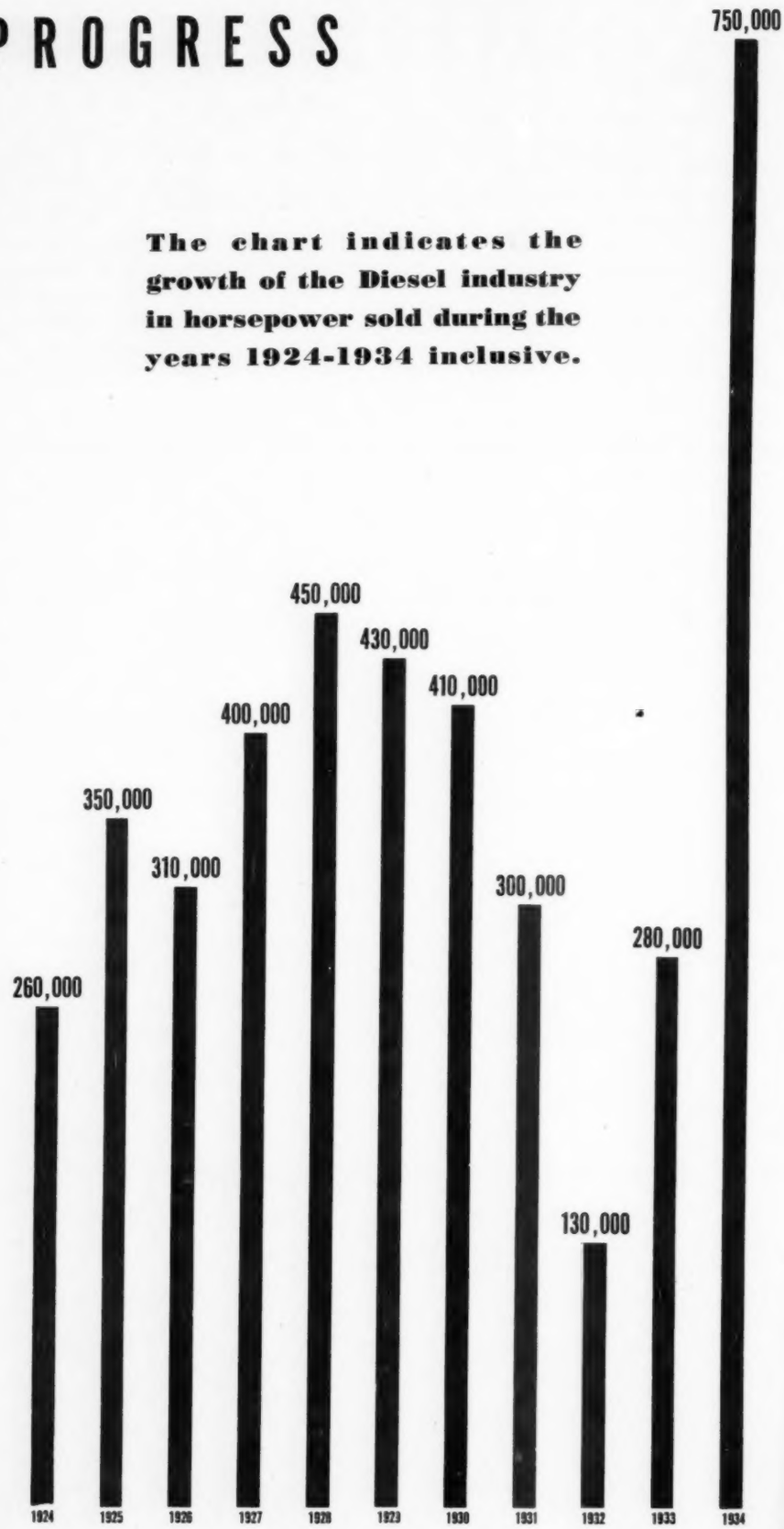
Although the sale of Diesel horsepower had fallen off tremendously due to the depression, the industry still had many years of development and research work behind it, so that when the tide turned and money became available for increased Diesel purchases, the Diesel industry was one of the first to recover. This recovery is all the more remarkable, because this industry is classed among the durable-goods industries where recovery is thought to be both slow and tedious.

In 1933, the horsepower sales recovered to the extent of 280,000 hp. and for the year 1934, all previous sales records were broken with the amazing total of 750,000 hp. How shall one account for this remarkable recovery? Largely by the fact, that industry and transportation are turning to Diesel engines more and more because of their reliability and economy. Years of development and research have gained recognition for the superior qualities of the Diesel engine for many and various types of service.

New uses for Diesel engines are continually developing, and engines to meet new requirements are being constructed. In the transportation field alone, increasing demands have stepped up production tremendously for Diesel tractors, buses, trucks, streamline trains and aircraft.

Diesel Progress is pleased to present this encouraging picture of progress in the Diesel engine industry, and pledges its full support to further Diesel development and increase Diesel sales.

The chart indicates the growth of the Diesel industry in horsepower sold during the years 1924-1934 inclusive.



1.

2.

3.

4.

5.

1. COLONEL ROBERT H. MORSE

President, Fairbanks, Morse & Co., Chicago, Illinois. To whom credit is due for producing a black balance sheet for his stockholders to the tune of half a million net profit for 1934.

2. GEORGE W. CODRINGTON

President, Winton Engine Corporation, Cleveland, Ohio. To whom credit is due for a most successful year in 1934. Winton turned a handsome sum into the coffers of the General Motors Corporation for the benefit of its many stockholders.

3. B. C. HEACOCK

President, Caterpillar Tractor Company, Peoria, Illinois. To whom credit is due for the outstanding record of producing the most Diesel Engines in 1934 ever produced by any one manufacturer and for making the net sum of $3,651,190 in 1934 for his stockholders.

4. FRED M. YOUNG

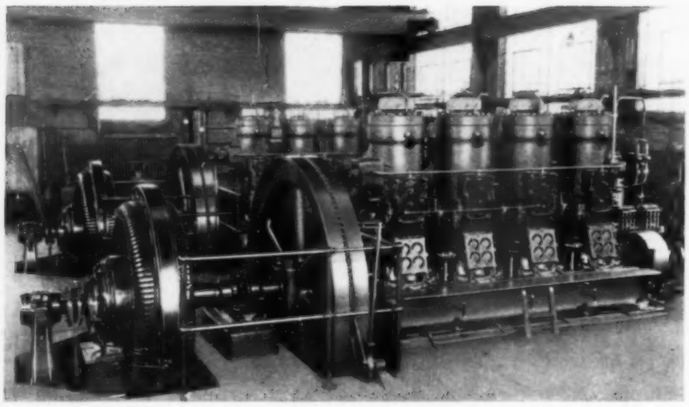
President, Young Radiator Company, Racine, Wisconsin. To whom credit is due for solving many of the radiator and oil cooling problems of the industry.

5. GEORGE N. SOMERVILLE

Sales Manager, Atlas Imperial Diesel Engine Co., Oakland, Cal. To whom credit is due as one of the outstanding sales executives in the industry.

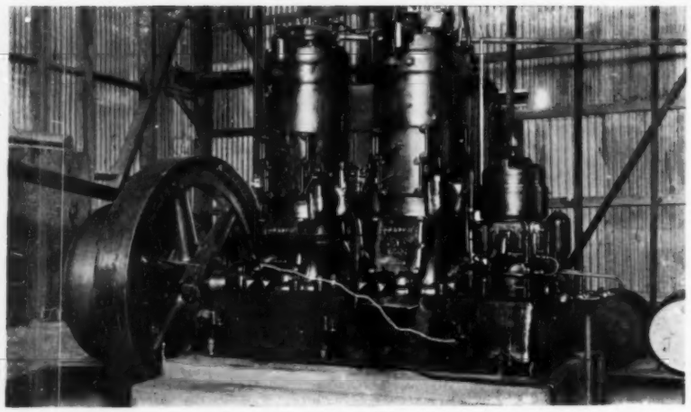
HALL OF FAME

FROM COTTON GINS TO YACHTS



A 1916 INSTALLATION

The average cost of replacement parts for each one of these 360 hp. engines during the eight-year period, 1926-1933, was only $60.00 per year. This figure is the more remarkable when taking into consideration that these engines have been in constant operation for 19 years and are still running 365 days a year. Put in commission in 1916, these engines have been operating continuously, giving efficient uninterrupted service at a Municipal Electric Light Plant in New Jersey.

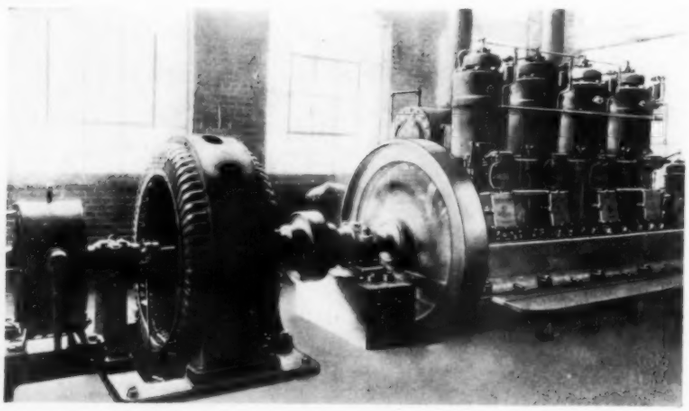


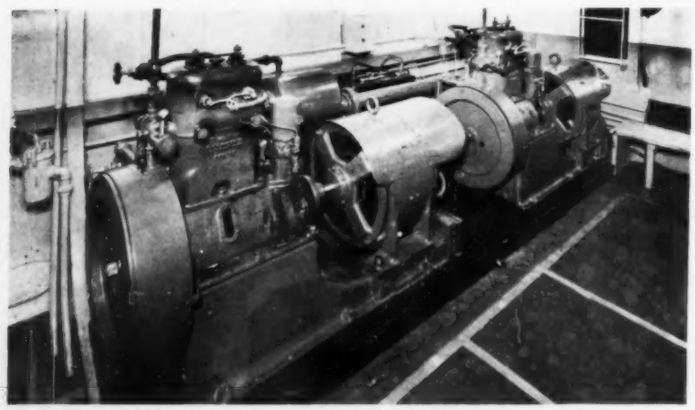
A 1925 INSTALLATION

A 150 hp. Bolinders engine driving two Murray Gin outfits at N. R. Legg Gin Co., McGregor, Texas, was installed June, 1925. After changing from electric power to Bolinders engine the owners reduced power costs from 94 cents to 10 cents per bale, a saving of 84 cents. Even when operating only three months a year, this engine is able to save its owners $3,000 a year.

A 1926 INSTALLATION

Still going strong after nearly ten years of operating a direct-connected generator supplying power for seed handling devices, cake mill and cotton gin. A 300 hp. Bolinders engine in the plant of the New South Oil Co., Helena, Ark.





A 1931 INSTALLATION

Two 12-15 hp. Bolinders Diesel engines driving electric generators, which act as the auxiliary power plant for the triple screw Diesel yacht "Vixen." These small auxiliary engines use the same fuel as the large main engines, so only one kind of fuel has to be carried on board. Electric current can be produced with these engines at a fuel cost of less than one cent a kw.

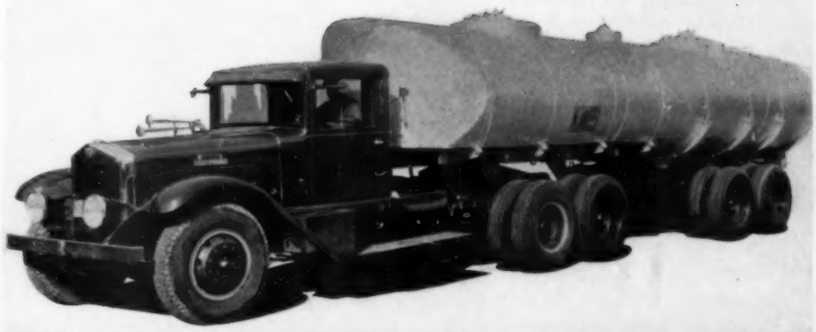
TRUCK OPERATORS REPORT SAVINGS

A tank truck operator reports: "There is a saving of between 75% and 80% in fuel cost; double the mileage per gallon compared with gasoline motors of the same horsepower. I figure, according to my records, that I have effected an actual saving in the operation of these three trucks of approximately $8,000.00. On account of the tremendous saving effected in my cost, I am naturally enthusiastic over the successful performance of Sterling-Diesel trucks and will purchase nothing but Diesel-Powered trucks in the future."

A wholesale milk dealer reports: "Up to date this Sterling-Diesel tractor has traveled over 35,000 miles with a total fuel oil consumption of approximately 5,000 gallons, or a total cost of $350.00 which makes an average of 1c a mile for fuel cost. Our main purpose in purchasing this unit was of course to reduce operating costs, and the above figures substantiate all the claims made for a Sterling-Diesel powered truck or tractor."

A refrigerating truck operator reports: "We will have fourteen Diesel-Powered trucks in our fleet as soon as we receive the four we have on order with you. Our annual saving in fuel and operating costs on this fleet will be in excess of $25,000.00 over gasoline-powered trucks of same capacity."

A motor freight line reports: "We find our Sterling-Diesel trucks to be all you say they are in the way of economy, efficiency and performance, and we heartily recommend them to any operator who wishes to cut his operating costs and at the same time step up his efficiency."



Left — Typical types of Diesel operated trucks

Below—On the Sterling production line.

SMALL YACHT DIESEL

. . . . *Continued from page 8* . . .

for more than twenty years to give them their maximum driving efficiency cannot help but give to anyone who has pondered the problems of marine engine performance certain clear-cut ideas on engines and the selection of the right type for every use. For yacht work I am strongly inclined to multi-cylinder Diesels instead of the two-, or four-cylinder jobs. to get a perfectly smooth-running boat. I think the trend here is unmistakably in this direction.

There is no reason why small marine Diesels should not play afar more important role in the small yacht field in the future than they have up to the present. They are practically foolproof and are no more difficult to service and repair than a gasoline engine.

Today it is no problem at all to find mechanics who are thoroughly conversant with Diesel motors, as it once was. Commercial craft have paved the way in advance for yacht service. Fuel oil in whatever grade your Diesel requires is now available at boating centers nearly everywhere.

There has been a great demand in recent years for small auxiliary schooners and motor sailers, craft with extreme seaworthiness, roomier living quarters, wider cruising radius and more economical to operate, as differing from high-speed power cruisers not so comfortable in rough water and heavy seas. Diesels seem to be the most favored type of engine for these auxiliary craft in which owners want ample cruising radius and economy of operation, rather than simply speed.

A large proportion of strictly power small yachts could be Dieselized to advantage right now. Many undoubtedly will be within the next few seasons, with the rapid advances in engine improvements and more vigorous merchandising on the part of Diesel engine builders.

The small marine Diesel is coming fast. Stock boat builders whose fingers are on the yachting pulse have lost no opportunity to tell their customers that Diesel power can be had if the owner requests it.

Mass production by the engine manufacturer who has the best knowledge of the small boat field may be the next step that will bring the small Diesel into place Number One.

BERLIN MOTOR SHOW

. . . . *Continued from page 16* . . . .

50 hp. is 3,400 marks, or 7,400 marks for 135 hp.

The well-known firm of M.A.N., at which works the Diesel engine was originally developed by Dr. Rudolf Diesel and Dr. Immanuel Lauster, had no fewer than 25 engines and vehicles on exhibit, including three rail car Diesels. One of their engines in the Hall of Honor is an all-steel model rated at 110 hp. from a piston-swept volume of 12,200 cubic centimeters. By electric welding the weight has been reduced by 15 per cent. The M.A.N. recently won a competition for Diesel vehicles in Russia, the route being from Moscow to Tiflis, a distance of 5,150 kilometers.

Out of a total of 68,760 commercial vehicles of over 2½ tons registered in Germany on 1st of July, 1934, no fewer than 12,000 have Diesels, and the number is increasing very rapidly, as the construction of gasoline-driven trucks and busses had practically ceased. Of new vehicles registered last July the Diesel percentage was 75 per cent, as compared with 65 per cent in 1933 and 45 per cent in 1932, so the speed of growth is obvious. There also are in service 30,000 Diesel tractors, mostly in agricultural service, aside from Diesel-driven rail cars, tank cars, fire engines, etc.

The reason for this rapid development is understood when it is mentioned that today oil fuel costs in Germany are 78½ per cent less than the benzine-benzole mixture used by gasoline trucks, while the cost of operating and maintenance are no higher. The Diesel-driven road tank car of the "Olex" oil company (Anglo-Persian Oil Company) was placed in service in January, 1930, and has since run 100,000 kilometers with satisfactory results.

Today the average price paid in Germany by the average owner of a fleet of busses or trucks is 43 rm. per kilos for the benzine-benzole mixture; whereas gasoil as now used by high-speed Diesels only costs him 11.50 rm. per 100 kilos, and the Diesel consumes considerably less per horsepower hour than the gasoline motor. A two-ton lorry carrying 3½ tons, with an engine of 80 hp., costs 18 rm. per 100 kilometers for gasoline fuel, and 3.90 rm. for Diesel.

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5. Portable and Mobile Diesel Applications.
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7. Operating the Bessemer Four-Stroke Cycle Solid Injection Engine.
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11. Engineering the Diesel Plant.
12. Engineering the Diesel Plant, continued.
13. Efficient Lubrication.

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. . . . *Continued from page 22* . . . .

cause shafts, propellers and other parts are all interchangeable on the six ships. The stock of spare parts we carry is very much less than we would need if their engines were of varied installations."

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Each of the six sister trawlers has a fuel storage capacity of 6,000 gallons, ample for the runs they have to make in all kinds of sea and weather.

Not a single major replacement has been necessary on their engines since the ships were placed in commission. A careful overhauling once a year and a regular inspection at the end of each trip keeps them running smoothly and on schedule.

"The operator of a fishing fleet has to remember that there are no machine shops on the ocean or service stations scattered along the fishing banks," says Bart Whalen, president and general manager of R. O'Brien & Co. "Fishing is altogether different from coastwise shipping. There are no convenient ports you can put into for repairs if things go wrong. You've got to have power that you can *depend* upon!"

Note this. During the worst part of the depression just passed, when part of the fishing fleet had to be tied up, owners didn't tie up Diesel ships. They were kept in service.

Some Sunday you may hear the parable of the loaves and fishes. But you'll never hear of a *ship* that *loafs* and fishes. The ship that loafs simply can't compete. A fishing vessel today must work and pay its way – or make room for one that can.

The fishing industry is looking to 1935 for its best year since 1929 when the per capita consumption of fish in this country was as high as 23 pounds as compared with 15 pounds in 1934.

A tremendous educational campaign to be cooperatively undertaken by the industry and government agencies is now getting under way. Now, if ever, their trawlers must bear the load.

Have Diesels proved their mettle in the fishing fleet? Ask R. O'Brien & Company!

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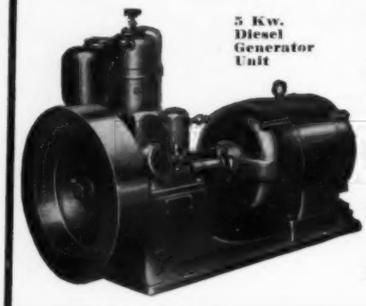

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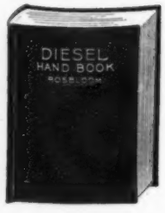

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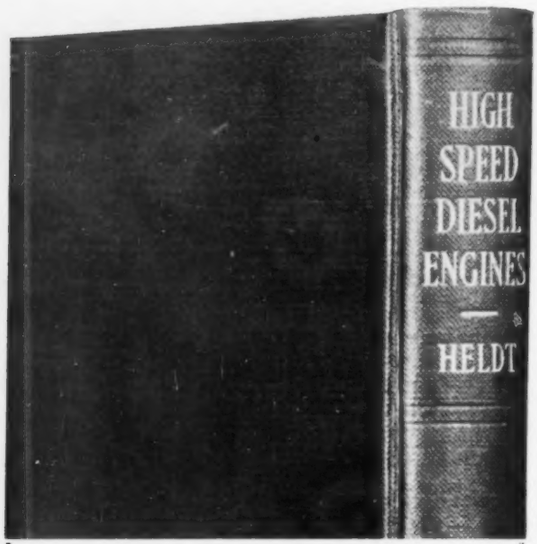

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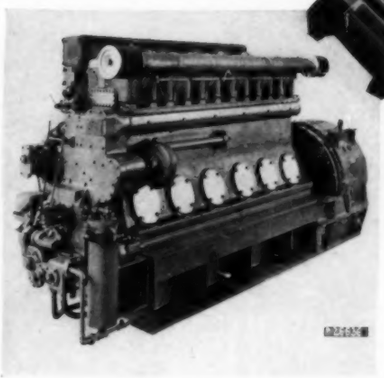

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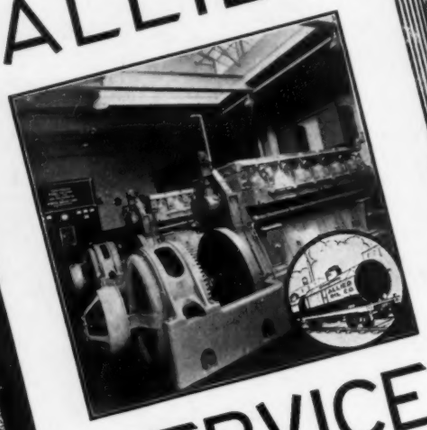

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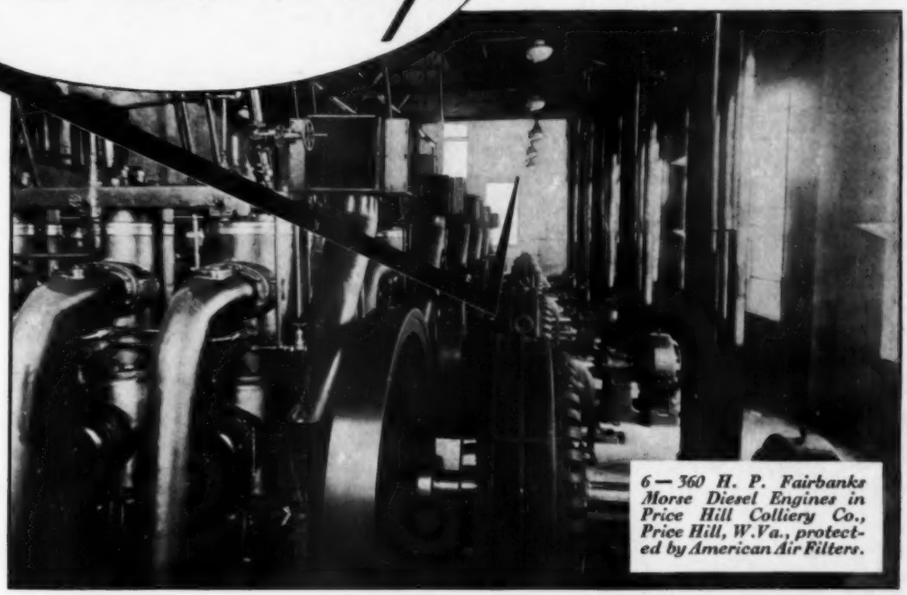
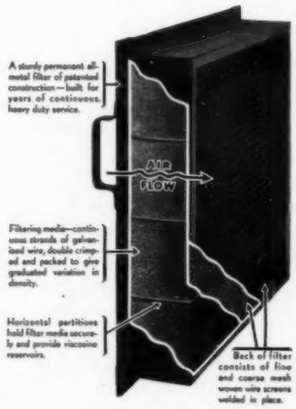


6 — 360 H. P. Fairbanks Morse Diesel Engines in Price Hill Colliery Co., Price Hill, W.Va., protected by American Air Filters.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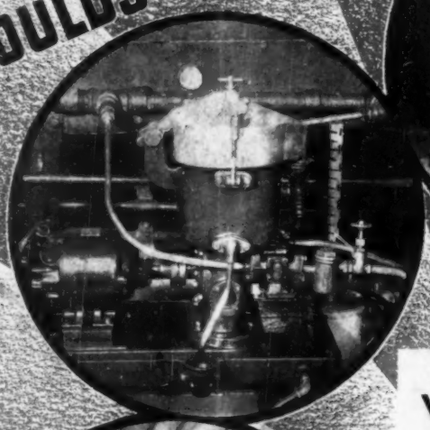

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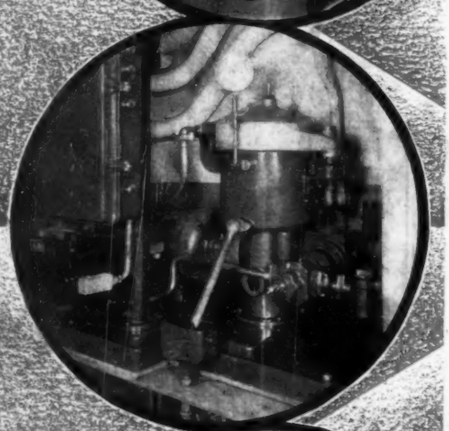
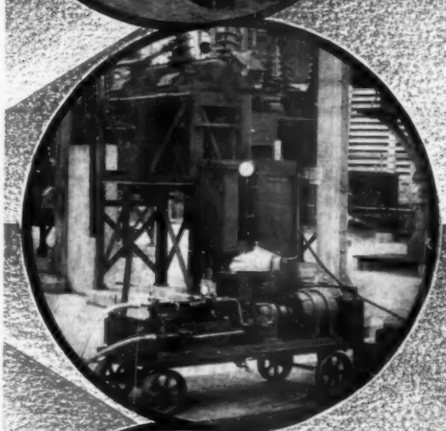
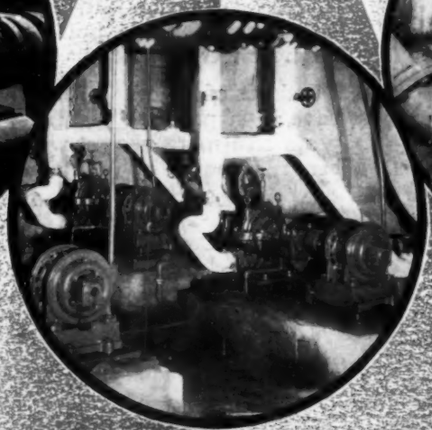
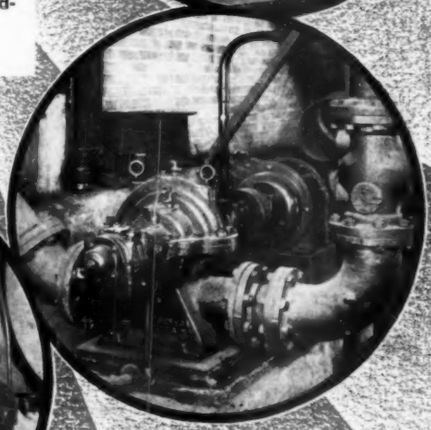
Goulds complete line of centrifugal, rotary and reciprocating pumps fill every pumping requirement in the Diesel operated plant. Efficient and dependable. Write for complete details.









PUMPS AND PURIFIERS FOR EVERY PURPOSE IN THE POWER PLANT

GOULDS PUMPS Inc.

SENECA FALLS N. Y.

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